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AUTHOR	Kline, Ken
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ABSTRACT

As part of a model construction cluster curriculum development project, this guide was developed and implemented in the Beaverton (Oregon) School District. The curriculum guide contains 16 units covering the following topics: introduction to construction jobs; safety and first aid; blueprint readings; basic mathematics; site work; framing; roofing materials; exterior siding and trim; plumbing; electrical work; insulation; dry wall; interior trim; trowel trades; painting and wall coverings; and floor coverings. Each unit contains one or more lessons with the following elements: unit goals; specific objectives; information sheets in outline format; and problems for solution. A bibliography and references complete the guide. (KC)

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CURRICULUM GUIDE

CONSTRUCTION CLUSTER

Developed as a Part of Model Construction Cluster Project

Project Grant No. 34-048-186

by Ken Kline
Beaverton High School

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August, 1982

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TABLE OF CONTENTS

Unit	Title	Page
1.0	Introduction Unit	1
	1.1 Orientation	1
	1.2 Applying For Jobs	4
	1.3 Job Attitudes	14
	1.4 Communication Skills	16
2.0	Safety and First Aid	20
3.0	Blueprint Readings	21
	3.1 Terms and Definitions	22
	3.2 Alphabet of Lines	25
	3.3 Description of Lines	25
	3.4 Floor Plan Symbols	26
	3.5 Reading a Scale	27
4.0	Basic Math	34
	4.1 Terms and Definitions	35
	4.2 Addition, Subtraction, Multiplication and Division	37
	4.3 Fractions	39
	4.4 Decimals	42
	4.5 Area Calculation	52
5.0	Site Work	55
	5.1 Builder's Level and Transit	55
	5.2 Locating the Building	64
	5.3 Forming	69
6.0	Framing	74
	6.1 Floor and Sill Framing	75
	6.2 Walls and Partitions	83
	6.3 Roof Framing	95
	6.4 Trusses	104
7.0	Roofing Materials	108
8.0	Exterior Siding and Trim	111
9.0	Plumbing	117
10.0	Electrical	122
11.0	Insulation	126
12.0	Dry Wall	129
13.0	Interior Trim	133
	13.1 Stair Construction	133
	13.2 Door Hanging	141
	13.3 Cabinet and Shelf Insulation	148

TABLE OF CONTENTS

Unit	Title	Page
14.0	Trowel Trades	152
15.0	Painting and Wall Coverings	157
	15.1 Painting	158
	15.2 Papering	160
16.0	Floor Coverings	163
	16.1 Terms and Definitions	164
	16.2 Estimating Tile	166
	16.3 Estimating Carpet	167
	16.4 Installation	168
	16.5 Underlayment	171
	Bibliography and References	172
	Appendices	173

INTRODUCTION UNIT 1

1.1 Orientation

UNIT GOALS

After completion of this unit, the student should be able to name place of employment and list facts concerning the occupational outlook for construction cluster occupations. The student should be able to list student requirements and name major skills involved in those trades. The student should complete a personal information sheet. This knowledge will be evidenced by completion jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. List facts concerning the occupational outlook for construction occupations.
2. Name employment opportunities.
3. List student requirements for the carpentry program.
4. Name major skills involved in construction cluster occupations.
5. Complete a personal information sheet.

INSTRUCTIONAL INFORMATION UNIT 1

1.1 Orientation

1. Occupational outlook
   - A. Job opportunities result each year from the need to replace experienced carpenters who retire or die
   - B. Number of new houses being constructed each year requires more carpenters to construct and maintain them
   - C. Specialization has created more job opportunities and more desirable working conditions
2. Employment opportunities
   - A. Independent and union-affiliated residential building contractors
   - B. Independent and union-affiliated commercial contractors
   - C. Building maintenance for large office buildings or corporations
   - D. Pre-fab shops
   - E. Lumber yards
3. Student requirements for the carpentry program
   - A. Operate all power tools correctly
   - B. Be safety conscious and follow safety requlations
   - C. Take instructions readily and follow directions
   - D. Be a good citizen
   - E. Control temper at all times
   - F. Display enthusiasm about work
   - G. Exhibit pride in the carpentry trade
   - H. Practice conservation of materials and work-hours
   - I. Be punctual

1.1 Orientation (Continued)

4. Major skills involved in carpentry
   - A. Blueprint reading
   - B. Measuring
   - C. Using hand tools
   - D. Using power tools
   - E. Making material estimates
   - F. Erecting a building

1.2 Applying for Job

UNIT GOALS

After completion of this unit, the student should be able to locate a job opening, make a formal application, and effectively interview for a job. This knowledge will be evidenced by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with applying for a job to the correct definitions.
2. List means of locating job openings.
3. List methods of applying for a job.
4. Select from a list personal attributes or attitudes an employer looks for during a personal interview.
5. Select from a list guidelines for dressing for an interview.
6. List items which an applicant may need to prepare when applying for a job.
7. Select from a list guidelines to follow when participating in a job interview.
8. Write a resume.
9. Write a letter of application for a carpentry job.
10. Complete employment application form for a job as a carpenter.
11. Practice interview questions.
12. Make an appointment by phone for a carpentry job interview.
13. Write a follow-up letter or make a follow-up phone call after interviewing for a carpentry job.
14. Evaluate a carpentry job offer.
15. Compare job opportunities.

1.2 Applying for a Job

1. Terms and definitions

   A. Award-Recognition received for outstanding achievement

   B. Extracurricular activities--Clubs, organizations, and social or church groups in which one participates

   C. Fringe benefits--Extras provided by an employer, such as paid vacations, sick leave, and insurance protection

   D. Qualifications--Experience, education, and physical characteristics which suit a person to a job

   E. Resume--Brief, typed summary on one's qualifications and experience that is used in applying for a job

   F. Vocational preparation--Any vocational courses and skills one has learned in high school or through work experience

   G. Interview--Meeting of employer and job applicant for purpose of evaluation and questioning

   H. Application form--Printed form on which job applicants record information about their personal history, job history, job experience, education, and references

   I. Blind ad--Classified advertising that does not identify the advertiser

      (NOTE: Applicant is asked to send a letter of application and resume to a post office box number or to call a certain number.)

   J. Help-wanted ad--Classified advertisement telling what kind of job is available and what the qualifications are

   K. Employment-/situation-wanted ad--Classified advertisement placed by individuals seeking employment and telling what their qualifications are

   L. Employment agency--Business that is designed to help individuals find employment

   M. Garnishee--To attach wages or other property to satisfy a debt

1.2 Applying for a Job (Continued)

N. Legible--Capable of being read; clear

O. Equal opportunity employer--Employer who is making a special effort to assure that no form of discrimination is practiced

Examples: Age, sex, race, creed

2. Means of locating job openings

A. Classified ads

1. Newspapers

2. Magazines

B. Employment offices

1. Department of Labor

2. Private

C. Local labor union business office

D. School officials

1. Teachers

2. Counselor

3. Principal

3. Methods of applying for a job (Assignment Sheet # 5)

A. Letter

B. Telpehone

C. In Person

4. Personal attributes or attitudes an employer looks for during a personal interview (Transparency, Assignment Sheet)

A. Enthusiasm and interest

B. Dedication and dependability

1.2 Applying for a Job (Continued)

C. Alertness, quickness of mind

D. Honesty and integrity

E. Desire to work

F. Desire to help others

G. Desire to improve one's self

5. Guidelines for dressing for an interview (Transparency)

A. Job-related guidelines

1. Kind of job

(NOTE: A "rule of thumb" for any job interview is to dress better for the interview than you would for a day on the job.)

2. Salary range

B. Personal guidelines

1. Coordinate clothing

2. Be conservative

3. Be modest and well-groomed

6. Items which applicant may need to prepare when applying for a job (Assignment Sheets)

A. Resume

B. Letter of application

C. Application form

D. Follow-up letter

1.2 Applying for a Job (Continued)

7. Guidelines to follow when participating in a job interview (Transparency)

A. Preparing for the interview (Assignment Sheet)

1. Be clean

2. Be well-groomed and neat

3. Wear appropriate clothes and shoes for the type of job

4. Take an ink pen and resume with the information you may need about social security number, references, names and addresses, dates employed, and dates attended school

5. Go alone; do not take parents or friends

6. Do not be late; allow enough time

7. Find out facts about the interviewer ahead of time

a. Name

(NOTE: Make sure you have the correct pronunciation.)

b. Title

8. Know facts about the business

a. Name

b. Kind of business

c. Products and services

d. Reasons you want to work there

e. How old the company is and where the plants, offices, or stores are located

B. Meeting the receptionist/secretary

1. Smile

1.2 Applying for a Job (Continued)

2. Introduce yourself, stating that you have an appointment

   Example: "Good morning, I'm Terry McKracken and am applying for a job as rough framing carpenter. I have a 10:00 appointment with Mr. Smith."

3. Follow receptionist's/secretary's instructions

4. Wait patiently

C. Starting the interview

1. Smile

2. Listen

3. Enter with poise

4. Greet the interviewer by name

5. Shake hands firmly

6. Introduce yourself

7. State purpose of call

8. Be seated only at interviewer's invitation

9. Do not show signs of nervousness

   (NOTE: If you do not know where to put your hands, leave them on your lap and keep them still.)

10. Do not place personal things on interviewer's desk

11. Do not smoke or chew gum

12. Look alert; look interested and enthusiastic

    (NOTE: Sit slightly forward in chair to give an alert appearance.)

13. Be confident

1.2 Applying for a Job (Continued)

14. Be courteous

(Note: Words such as Mr., Mrs., Miss, Ms., thank you, please and sir never go out of style.)

D. Answering questions clearly

1. Do not interrupt

2. Anticipate questions that might be asked and volunteer proper information

a. Explain yes and no answers

b. Avoid criticisms of former employers or competitors

c. Do not talk about personal problems

d. Show copies of your work if applicable

e. State that you are willing to start at the beginning salary

f. Answer all questions honestly

Examples: "The thing I liked least about my last job was that I was on the night shift and couldn't get changed. I really wanted to be home with my family at night."

"Truthfully, my relationship with my supervisor could have been better; we seemed to have a personality conflict and never became fond of each other. However, we did manage to work together. This was my first experience like that and I surely hope it doesn't happen again."

g. Give positive answers to unfavorable questions

Examples: Interviewer: "Your work experience doesn't seem to relate specifically to this job. Why do you feel qualified to fill this position?"

1.2 Applying for a Job (Continued)

Applicant: "I understand your concern. However, my job experience is broad enough to permit me to work into this particular situation. I have done work similar to this job and I think my general work record is good enough to convince you that I would be a good employee. I would be willing to receive additional training."

h. Find a true, positive statement about your reasons for leaving previous jobs, even if you were fired

Examples: "I was laid off, but I learned from my mistakes."

"I left because they did not need as many employees during the slow season."

i. Try to mention your best qualities in relation to something concrete

Example: "I earned 75 percent of my expenses while going to school" is better than "I am hard worker and want to get ahead"

j. Be prepared for personal questions about your home life and parents' occupations

k. Avoid questions concerning politics, economics, religion, and other controversial subjects

l. Answer questions about career objectives using specific terms about what you would like to do in the near future in that particular field without limiting your opportunities

Example: A position as a carpenter that will lead to a supervisory position. No locational preference

3. Look directly at interviewer

4. Speak in clear, moderate tones

1.2 Applying for a Job (Continued)

5. Use correct English

(NOTE: Avoid swearing, slang terms, or annoying phrases like "yea," "you know," or "uh-huh.")

6. Show interest in the business; ask questions

Example: Incorrect: "Listen, I need to know if you have any benefits."

Incorrect: "Now that you've questioned me, there are a few things that I want to know before I decide if I want to work for you."

Correct: "I wonder if you could give me some information about the benefits available to employees?"

7. Sell yourself

(NOTE: Never refer to yourself as just average or fair. Always look for a positive response.)

8. Do not get flustered

9. Give the interviewer the opportunity to mention salary and fringe benefits

10. Act enthusiastically

E. Closing the interview

1. Watch for signs that the interview is over, such as the interviewer shuffling papers and moving around in chair

2. Ask "May I say one thing more?" or "Would you be interested in...?" if the interview seems to be ending before all important selling points have been made

3. Thank interviwer for his/her time

Example: "I've enjoyed talking to you, Mr. Smith. Thank you for your time and consideration. I'm excited about this job and do hope I'm hired. Can you tell me when the position will be filled and how the applicants will be notified? (Answer) Please let me know if you need any additional information."

12

1.2 Applying for a Job (Continued)

4. Learn from every situation even if the interviewer does not offer the position

F. Following up the interview--Write thank you letter, call, or visit again to express interest in the job and appreciation for the opportunity to interview .

1.3 Job Attitudes

UNIT GOALS

After completion of this unit, the student should be able to list facts concerning job values, aptitudes, potential and their importance for job success. This knowledge will be evidenced by completion of various assignments, and a unit test with a minimum of 85% accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to

1. List facts concerning job responsibilities
2. List 5 reasons people are fired from jobs

1.3 Attitudes on the job

1. Job Responsibility

   A. Learn job as quickly as possible

      1. employer wants service or work performed

   B. Be careful on the job

   C. Accept criticism

      1. avoid the chip on the shoulder attitude
      2. as skills increase, criticism will decrease

   D. Be at work daily

   E. Be on time

   F. Follow company rules

      1. rules may seem silly
      2. look for written rules
      3. watch other employees for unwritten rules

   G. Be courteous

   H. Be responsible

   I. Be honest

      1. there is no room for cheating, lying, or stealing

   J. Be proud of the job

   K. Work hard

      1. be willing to accept work that is not enjoyed
      2. put in a full days work for a full days pay

1.4 COMMUNICATION SKILLS

UNIT GOALS

After completion of this unit, the student should be able to be more effective in listening, and eliminate the common misunderstandings that arise from spoken conversations. Also the student should be able to take better and briefer notes. This knowledge will be evidenced by completed jobs and assignments, and completion of a unit test with a minimum of 85% accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Remember more of what the student hears
2. Eliminate common misunderstandings arising from spoken conversations
3. Improve ability to follow verbal instructions on the job
4. Take brief and complete notes

1.4 Communication skills

1. How listening differs from hearing
   - A. Hearing depends on the ears, but listening uses the mind and the eyes
   - B. Improve listening by improving listening tools
   - C. All employees must know how to listen
2. How to improve your listening
   - A. Prepare to listen
     1. determine purpose
     2. get ready to listen
     3. accept your share of responsibility
   - B. How to listen
     1. with understanding
     2. with an open mind
     3. listen actively
     4. listen with empathy
   - C. Always rephrase and review
   - D. Take notes
     1. will aid memory
     2. flag or underline important parts or instructions
     3. listen and write down special instructions

SUGGESTED ACTIVITIES 1.4

COMMUNICATIONS SKILLS

Reading: Assess reading levels by administering an Informal Reading Inventory (IRI).

Independent Level_____

Instructional Level_____

Frustration Level_____

Spelling: Assess spelling ability for common words. A suggested spelling list is given below.

1. employer	6. late	11. food	16. police
2. work	7. wage	12. cost	17. car
3. help	8. time	13. thank you	18. student
4. teacher	9. street	14. list	19. Oregon
5. store	10. tools	15. school	20. rent

_____% Correct

Written Communication: Write a series of sentences on a subject of interest to the student.

1.

2.

3.

4.

5.

Following Verbal Commands: Suggested commands are given below. If the student is unsuccessful in following the command(s) on the first attempt then the command(s) should be repeated before the next attempt. Indicate with an X which attempt was executed correctly.

<u>One Command</u>

1. Tell me your full name.

   1st Attempt _____ 2nd Attempt _____ 3rd Attempt _____

<u>Two Commands</u>

1. Put any five books on your desk.
2. Bring to me the book with the most pages.

   1st Attempt _____ 2nd Attempt _____ 3rd Attempt _____

Three Commands

1. Turn to page 32 in a dictionary.
2. Find a word with five or more letters.
3. Write the word backwards on this sheet of paper.

1st Attempt _____ 2nd Attempt _____ 3rd Attempt _____

Four Commands

1. Turn to page 3 in the telephone directory.
2. On a piece of paper write the phone number to call for the time.
3. Dial this number for the time.
4. Write the time on the chalkboard.

1st Attempt _____ 2nd Attempt _____ 3rd Attempt _____

Five Commands

1. Borrow a book on animals at the library.
2. Bring the book back to the room.
3. Write on a sheet of paper the title and author of the book.
4. Hand in the paper to me.
5. Return the book to the library.

1st Attempt _____ 2nd Attempt _____ 3rd Attempt _____

Six Commands

1. Get a dictionary.
2. Turn to page 100.
3. Pick out three words from that page.
4. Write the three words on a sheet of paper.
5. Circle each of the words.
6. Fold the paper in half.

1st Attempt _____ 2nd Attempt _____ 3rd Attempt _____

2.0 Safety and First Aid

UNIT GOALS

After completion of this unit, the student should be able to list rules for personal and general safety. The student should be able to list safety rules involving the immediate needs of a first aid victim, and the sequence of action applicable in case of serious injury. This knowledge will be evidenced by completion of assignment sheets and unit test with 100 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. List rules for personal safety.
2. List rules for general job safety.
3. Select from a list methods used to maintain a clean and orderly work area.
4. Identify the correct way to lift heavy objects.
5. List safety rules involving flammable liquids.
6. List the immediate needs of a first aid victim.
7. List the sequence of action applicable in case of serious injury.

Note: It is suggested that a school use their own set of safety tests. In the event there are none available, an example of Beaverton School District's are in the appendix.

3.0 Blueprint Reading

UNIT GOALS

After completion of this unit, the student should be able to identify the alphabet of lines and types of architectural drawings. The student should be able to list major items included in a set of specifications, and extract specific information from a set of specifications. This knowledge will be evidenced by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with blueprint reading to the correct definitions.
2. Identify types of lines included in the alphabet of lines.
3. Match the names of floor plan symbols to pictures of the symbols.
4. Match the names of electrical symbols to the correct symbols.
5. Match the names of sectioning symbols to the correct symbols.
6. List major items that should be included in a set of specifications.
7. Extract specific information from a prepared set of building specifications.

3.1 Blueprint Reading

1. Terms and definitions

   A. Alphabet of lines--Set of conventional symbols covering all the lines needed to depict an object as to size and shape

   B. Architect's scale--Rule divided into proportional feet and inches; a fraction of an inch is proportionally equal to one foot

      Examples: 1/8", 1/4", 3/8", 1/2", 3/4", 1 1/2", and 3" to the foot

   C. Architectural drawings--Graphic representations shown with lines and symbols

   D. Structural drawing--Plans showing the structural components of the building

   E. Mechanical drawing--Plans showing the plumbing and heating layout

   F. Electrical drawing--Plans showing the electrical installation

   G. Shop drawing--Plans showing detailed information of specific items

   H. Blueprint--Copy of the original detailed drawing

   I. Detail--Drawing that gives complete detailed information for an element of construction

   J. Dimensions--Arrangement of lines and symbols to indicate the actual size for constructing the object that is represented

   K. Elevation--Drawings representing the front, sides, or rear face of a structure and usually made as though the observer were looking straight at it

   L. Plan--In architecture, a diagram showing a horizontal view of a structure, such as floor plans and sectional plans

   M. Scale drawing--Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

3.1 Blueprint Reading (Continued)

N. Section--Drawing of an object that has been cut to show internal construction

O. Specifications--Detailed set of written instructions which explains the drawing, describes material and equipment used in the structure as to quality and types, and becomes part of the contract

P. Symbol--Arbitrary sign that has been standardized and is used to represent an object, quality, or method

Q. Engineer's scale--Rule divided into decimals and/or tenths

Examples: 1" = 1', 10' = 1', or 100' = 1'

R. Bench mark (BM--Metal or stone marker placed in the ground by a surveyor with the elevation indicated on it

(NOTE: This is the reference point for determining grades and elevations in the area.)

S. Datum point-Point with reference to which elevations are measured or indicated, such as a permanent bench mark

T. Change orders--Set of orders issued and signed by owner authorizing contractor to make a particular change

2. Types of architectural drawings (Transparencies)

A. Plot plan

B. Foundation plan

C. Floor plan

D. Elevations

E. Details

3. Characteristics of architectural drawings (Transparencies)

A. Plot plan

1. Location of the structure on the site

2. Finished and existing grade contours

3. Property lines

3.1 Blueprint Reading (Continued)

4. Utilities

5. Location of existing conditions

(NOTE: This would include trees, buildings, or other structures.)

B. Foundation plan--Location and size of footings, grade beams, foundation walls, stem walls, and piers

C. Floor plan

1. Outside walls including the location and dimensions of all exterior openings

2. Type of construction through the use of symbols

3. Location of interior walls and partitions

4. Location and swing of doors

5. Stairways

6. Location of cabinets and other built-ins

D. Elevation--Grade lines, floor heights, window sizes, roof lines, and/or other dimensions

(NOTE: Elevations and sections are very closely coordinated. Elevations are shown for all faces of the structure.)

E. Details

(NOTE: These drawings are primarily used to depict details of construction that are too small or not shown in sufficient detail on the plan or elevation drawings. They may be full size or to a larger scale than the plan, elevation, or sectional view.)

1. Windows

2. Mill work, trim, and specialty items

3. Ornamental iron

4. Doors (interior and exterior)

5. Built-ins

3.1 Blueprint Reading (Continued)

6. Door frames,

7. Stairs

8. Walls and partitions

(NOTE: Sections are used freely on these drawings.)

3.2 Alphabet of lines (Transparencies)

A. Object line

B. Dimension line

C. Extension line

D. Hidden line

E. Center line

F. Section line (cutting plane)

G. Break line, long

H. Break line, short

I. Phantom line

J. Leader

K. Fixture line

L. Section lining

3.3 Descriptions of types of lines (Transparencies)

A. Object lines--Show main outline of the structure, including exterior walls, interior partitions, porches, patios, and driveways

B. Dimension lines--Thin, unbroken lines which designate structure dimensions

C. Extension lines--Extend, but do not touch, the object lines; permit dimension lines to be drawn between them

3.3 Descriptions of types of lines (Transparencies) (Continued)

D. Hidden lines--Short dashes used to show lines that are not visible from that view

E. Center lines--Series of short and long dashes used to designate centers and provide a reference point for dimensioning

F. Section lines (cutting plane)--Heavy lines consisting of a series of one long and two short dashes and arrows at each end pointing away from the area that is cut away for the purpose of sectioning; show the direction from which the section is supposed to be viewed (Transparencies)

G. Break lines, long--Used when an area cannot or should not be drawn entirely; a ruled line with freehand breaks

H. Break lines, short--Used when an area cannot or should not be drawn entirely; a wavy, uneven freehand line

I. Phantom lines--Used to indicate alternate positions of moving parts, adjacent positions of related parts, and for repeated details

J. Leaders--Used to connect a note or dimension to a part of the structure

K. Fixture lines--Outline the shape of equipment and furnishings

(NOTE: These lines are light to eliminate confusion with object lines.)

L. Section lining--Used to draw the section lining in sectional drawings; different material symbol is used for each structure material; lightly drawn line

3.4 Floor plan symbols (Transparency)

(NOTE: Check architect's drawings for symbols for particular jobs.)

3.5 Reading a Scale

A. Rules for reading a scale

1. Select proper scale ratio
2. Be sure scale is laying flat on the surface being measured
3. Double check all measurements
4. Practice measuring from the center of one line to the center of the next line
5. Do not use a scale where dimensions are available

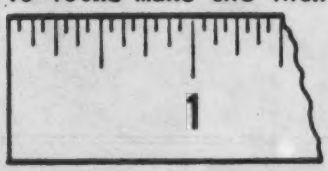
B. Common scales to which plans are drawn

1. 12" = 1'-0" (full scale)
2. 6" = 1'-0" (one-half scale)
3. 3" - 1'-0" (one-fourth scale)
4. 1/2" = 1'-0"
5. 1/4" = 1'-0"
6. 1/8" = 1'-0"

C. Interpreting graduations on the architect's scale

1. Full scale or 12" represents 1'

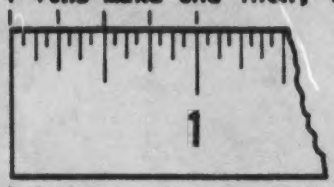
a. 16-16ths make one inch



b. 8-8ths make one inch; 2-1/6" make 1/8"

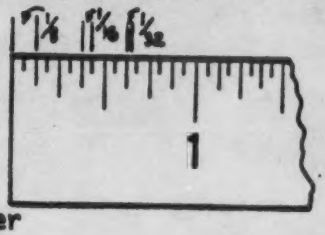
3.5 Reading a Scale (Continued)

c. 4-4ths make one inch; 4-1/6" make 1/4"



d. 2-1/2ves make one inch; 8-1/6" make 1/2"

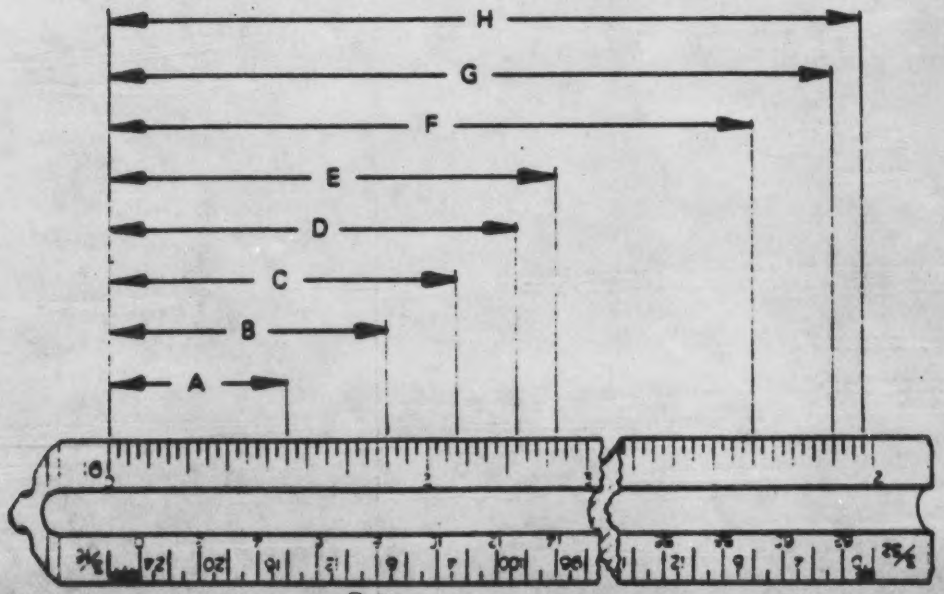
e. For 1/32" increments there are two 1/32" in one 1/16" and two 1/16" in one 1/8"



f. Dimensions are read in this order

1. Feet (')
2. Inches (")
3. Fractions of an inch

Example: Practice reading the following dimensions in inches and 1/16" (full scale)



3.5 Reading a Scale (Continued)

A = 1" + 2/16" = 1 2/16" or 1 1/8"

B = 1" + 12/16" = 1 12/16" or 1 3/4"

C = 2" + 3/16" = 2 3/16"

D = 2" + 9/16 = 2 9/16"

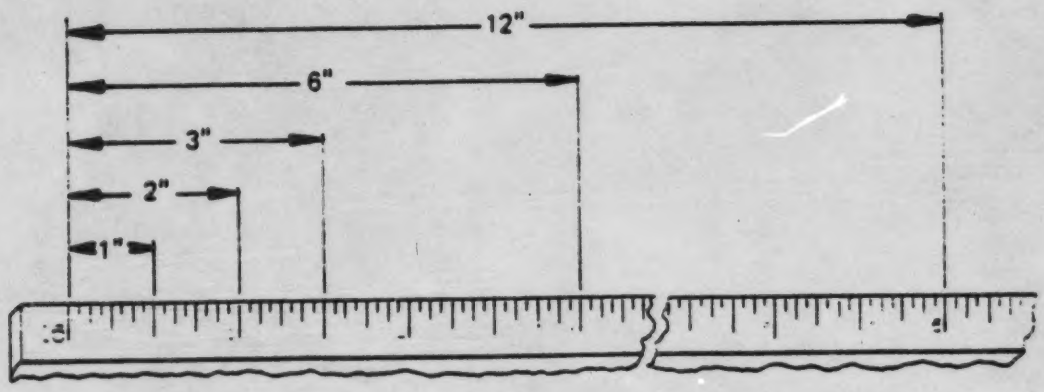
E = 2" + 13/16" = 2 13/16"

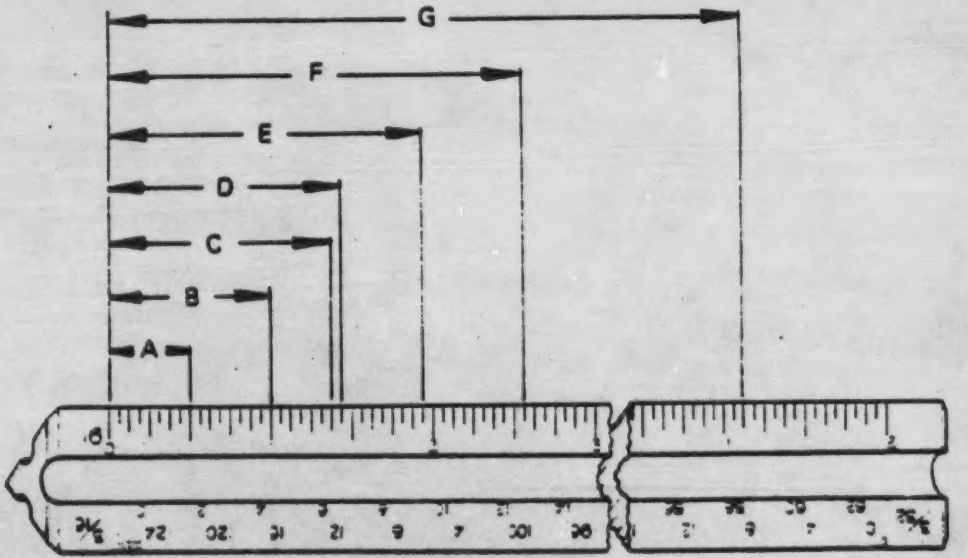
F = 11" + 4/16" = 11 4/16" or 11 1/4"

G = 11" + 12/16" = 11 12/16" or 11 3/4"

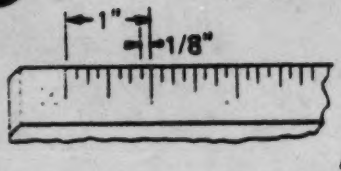
H = 11" + 15/16" = 11 15/16"

2. One-half scale or 6" represents 12" or 1'-0"





3.5 Reading a Scale (Continued)



At half scale the 1/16" graduations each represent 1/8"

A = 8/8" = 1"

B = 16/8" = 2"

C = 2" + 6/8" = 2 6/8" or 2 3/4"

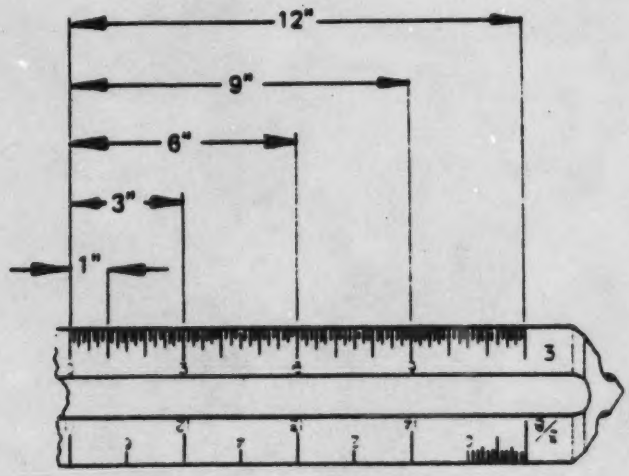
D = 2" + 7/8" = 2 7/8"

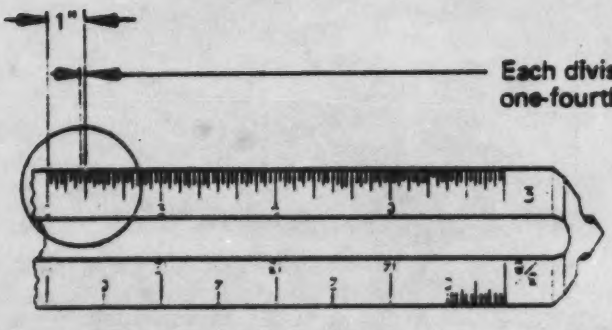
E = 3" + 7/8" = 3 7/8"

F = 5" + 1/8" = 5 1/8"

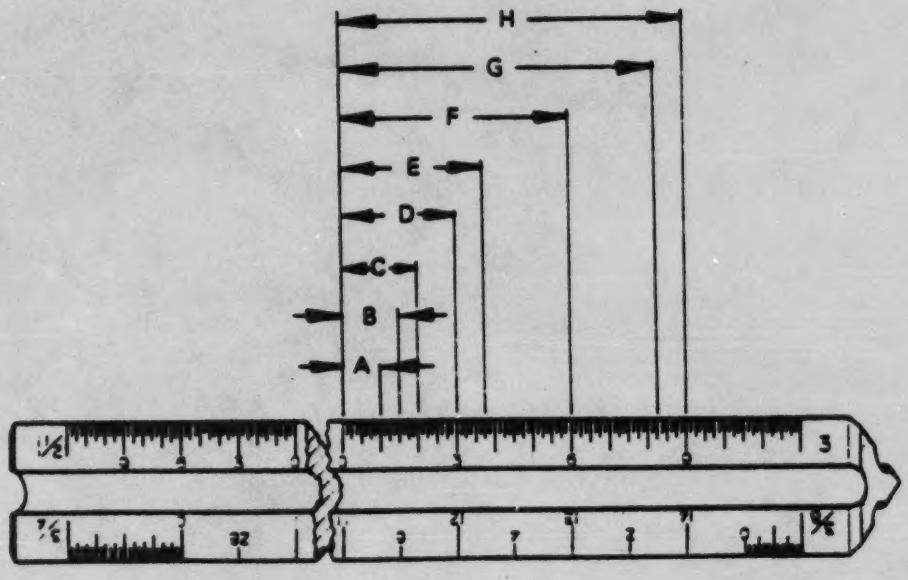
G= 22" + 2/8" = 22 2/8" or 22 1/4"

3. One fourth scale or 3" represents 12" or 1'-0"





3.5 Reading a Scale (Continued)



A = 8 graduations = 1"

B = 1" + 4/8" = 1 4/8" or 1 1/2"

C = 1" + 8/8" = 1 8/8" or 2"

D = 3"

E = 3" + 6/8" = 3 6/8" or 3 3/4"

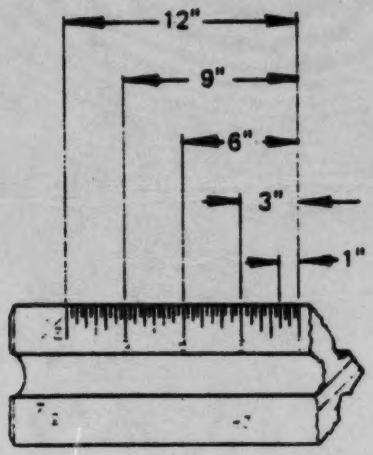
F = 6"

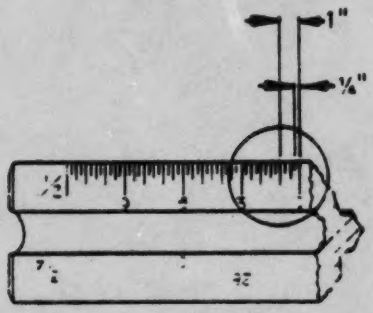
G = 8" + 2/8" = 8 2/8" or 8 1/4"

H = 9"

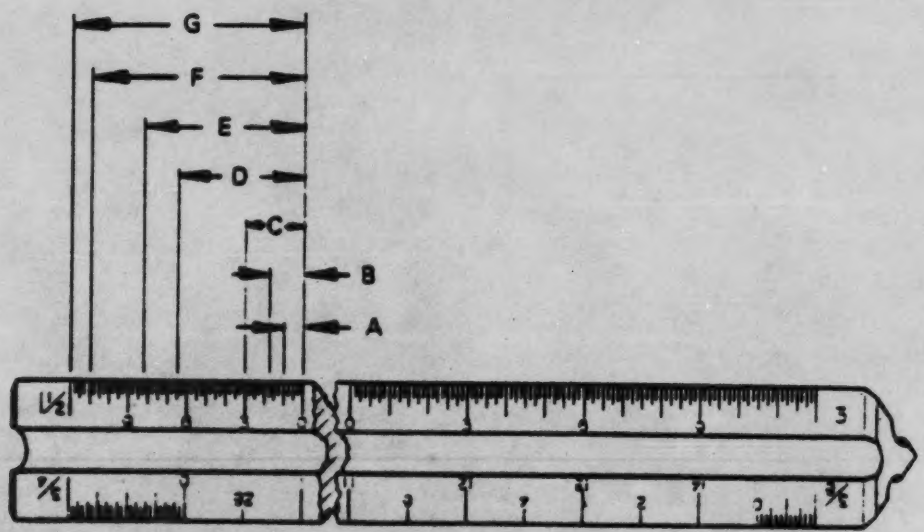
3.5 Reading a Scale (Continued)

4. One-eighth scale or 1 1/2" represents 12" or 1'-0"





This is one inch at 1/8" scale graduated into spaces that represent 1/4"



32

3.5 Reading a Scale (Continued)

A = 4 graduations = 1"

B = 1" + 3/4" = 1 3/4"

C = 3"

D = 6" = 2/4" = 6 2/4" or 6 1/2"

E = 8" + 1/4" = 8 1/4"

F = 11"

G = 12"

4.0 Basic Math

UNIT GOALS

After completion of this unit, the student should be able to calculate basic math problems. This knowledge will be evidenced by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Solve math problems involving addition.
2. Solve math problems involving subtraction.
3. Solve math problems involving division.
4. Solve math problems involving multiplication.
5. Reduce fractions to lowest terms.
6. Write numbers in decimal notation.
7. Write percents as fractions and decimals.
8. Solve problems involving percents.
9. Calculate basic math problems dealing with area.
10. Write the formula for figuring board feet.
11. Compute board feet and cost.
12. Write the formula for estimating concrete.

4.0 BASIC MATH

1. Terms and definitions

   A. Digit--Any one of the ten symbols, 0 to 9, by which all numbers may be expressed

   B. Addends--Numbers that are added together

      Example: 3 + 5 = 8 Numbers 3 and 5 are the addends

   C. Sum--Answer to an addition problem

      Example: 3 + 5 = 8 Number 8 is the sum

   D. Subtraction--Opposite (inverse) operation of addition

   E. Minuend--Number from which another number is being subtracted

      Example: 10 - 4 = 6 Number 10 is the minuend

   F. Subtrahend--Number which is being subtracted from another number

      Example: 10 - 4 = 6 Number 4 is the subtrahend

   G. Difference--Answer to a subtraction problem

      Example: 10 - 4 = 6 Number 6 is the difference

   H. Multiplication--Act of multiplying; at its simplest, an abbreviated process of adding an integer to itself a specified number of times

      Example: 5 x 3 = 15

   I. Integer--Any of the natural numbers; whole numbers

   J. Factors --Numbers that are multiplied

      Example: 2 x 3 = 6 Numbers 2 and 3 are the factors

   K. Product--Answer to a multiplication problem

      Example: 2 x 3 = 6 Number 6 is the product

   L. Division--Operation that is the opposite of multiplication

      Example: 15 ÷ 3 = 5

1. Terms and definitions (Continued)

M. Dividend--Number to be divided

Example: 15 ÷ 3 = 5 Number 15 is the dividend

N. Divisor--Number by which you divide

Example: 15 ÷ 3 = 5 Number 3 is the divisor

O. Quotient--Answer to a division problem

Example: 15 ÷ 3 = 5 Number 5 is the quotient

P. Remainder--Number left over when division is completed

Example: 15 ÷ 4 = 3 with a remainder of 3

Q. Prime factor--Has no factor except itself and one

Example 1 x 7 = 7 (prime)

R. Problem--Mathematical proposition

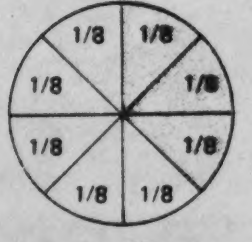
S. Arithmetic--Branch of mathematics that deals with real numbers and computations with these numbers

T. Computation--Act of computing or calculating

U. Calculate--To determine by mathematical process

V. Fraction--Tells what part of a whole thing; represents one or more of the equal parts of a unit

Example: If the unit is divided into eight equal parts, then each part is one eighth (1/8) of the unit. The fraction three-eights (3/8) means three of these parts, as shown in the shaded portion of the figure below



1. Terms and definitions (Continued)

W. Numerator--Tells how many equal parts of the whole thing are being considered; top number of the fraction

Example: In the fraction 3/8, the 3 is the numerator

X. Denominator--Tells into how many equal parts the whole thing is divided; bottom number of the fraction

Example: In the fraction 3/8, the 8 is the denominator

Y. Decimals--Special fractions whose denominators are numbers like 10, 100, 1,000, or 10,000; not written as common fractions but with the denominator shown by the position of a decimal point

Examples: 1/10 as a decimal = 0.1

6/100 as a decimal = 0.06

3/1000 as a decimal = 0.003

Z. Caret (^)--Mark made in writing to indicate place where something is to be inserted

AA. Percent (%)--"Per hundred;" division into 100 parts; another way of expressing a fraction whose denominator is 100

Example: 3% = 3 per hundred = 3/100 = 0.03

4.2 Addition, subtraction, multiplication, and division

1. Addition

A. Write the numbers one under another with the one's column in a straight line

B. Begin by adding on the right

Example:
$$\begin{array}{r} 1420 \\ 15 \\ +123 \\ \hline 1558 \end{array}$$

4.2 Addition, subtraction, multiplication, and division (Continued)

2. Subtraction

A. Minuend is larger than the subtrahend

B. Begin with the one's column and move to the left

Example:
$$\begin{array}{r} 784 \\ -431 \\ \hline 353 \end{array}$$

3. Division

A. Write the number to be divided as the dividend within the division frame; write the divisor outside

B. Determine how many times the numerals in the first few digits of the dividend may be divided by the divisor

C. Multiply the divisor by the trial quotient

(NOTE: The numeral in the unit's digit of the divisor is multiplied first, then tens, and so on.)

D. Place the product under the dividend

(NOTE: If the trial quotient is larger than it should be, the product will be greater than the dividend. When this happens, change the quotient to the next lower number.)

Example: 1974 ÷ 6 = 329

$$\begin{array}{r} 329 \\ 6\overline{)1974} \\ \underline{18} \\ 17 \\ \underline{12} \\ 54 \\ \underline{54} \\ 0 \end{array}$$

4. Multiplication

A. Write the larger factor above the smaller factor

(NOTE: Place the numbers in columns, ones in one's column, tens in ten's column, and so on.)

B. Multiply the numbers in the one's column; write the one's results in the one's column and carry over the tens

C. Multiply the ten's number in the top number by the one's numeral in the bottom number; add on the carry over

4.2 Addition, subtraction, multiplication, and division (Continued)

D. Write the first numeral on the right in this result in the ten's column

E. Carry over any numerals representing hundreds and add to the next result

F. Continue to multiply every numeral in the top factor by every numeral in the bottom factor

G. Add the results in each column

Examples: Multiplying by one digit

4 x 53 = 212

$$\begin{array}{r} 53 \\ \times\ 4 \\ \hline 212 \end{array}$$

Multiplying by two digits

42 x 174 = 7308

$$\begin{array}{r} 174 \\ \times\ 42 \\ \hline 348 \\ 696 \\ \hline 7308 \end{array}$$

Multiplying by three digits

619 x 825 = 510,675

$$\begin{array}{r} 825 \\ \times\ 619 \\ \hline 7425 \\ 825 \\ 4950 \\ \hline 510675 \end{array}$$

4.3 Fractions

1. Parts of a fraction

A. Numerator--Top number

B. Fractional line--Indicates division

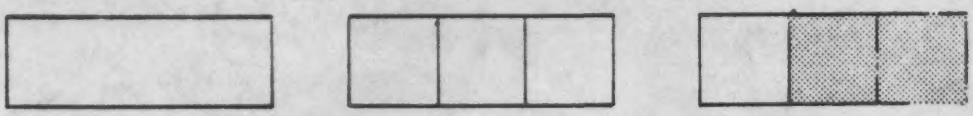
C. Denominator--Bottom number

Example: $\frac{3}{4}$ ← Numerator; ——— ← Fraction line; 4 ← Denominator

4.3 Fractions (Continued)

2. Drawing fractions--Fractions can be represented by dividing and shading figures

Example: 2/3



3. Solving fractional word problems

A. Draw figures to represent all the items

B. Shade the parts being considered

4. Types of fractions

A. Proper--Numerator is smaller than the denominator

Example: 3/9

B. Improper-Numerator is larger than or equal to the denominator

Examples: 8/6, 7/7

C. Mixed--Contains a whole number and a fraction

Examples: 9 1/2, 4 2/3, 1 7/8

5. Fractions which are equivalent to the number one--Fraction in which the numerator and denominator are the same (equal)

Examples: 4/4 = 1, 5/5 = 1, 25/25 = 1

6. Equivalent fractions--Two or more fractions which look different and are read differently but mean the same part of the whole thing

Example:

(NOTE: All three circles have different names, but all three shaded areas are equal.)

4.3 Fractions (Continued)

7. Equivalent fractions with a given denominator (Assignment Sheet # 16)

   A. Determine by what number the first denominator must be multiplied or divided to get the second denominator

   B. Perform the same operation with the same number on the numerator

   Examples: 1/4 = x/8; 4 x 2 = 8, 1 x 2 = 2;
   1/4 = 2/8

   12/15 = x/5, 15 ÷ 3 = 5; 12 ÷ 3 = 4;
   12/15 = 4/5

8. Converting mixed numbers to improper fractions--Multiply the denominator of the fraction times the whole number and add the numerator of the fraction (Assignment Sheet # 17)

   Examples:

   $$4\ 3/5 = \frac{(5 \times 4)}{5} + 3 = \frac{23}{5}$$

   $$7\ 1/2 = \frac{(2 \times 7)}{2} + 1 = \frac{15}{2}$$

9. Converting improper fractions to mixed numbers or whole numbers--Divide the denominator into the numerator and express the remainder as a fraction (Assignment Sheet # 17)

   Example:

   $$7\overline{)\begin{array}{r}1\\9\\7\\\hline 2\end{array}} = 1\ 2/7$$

   (NOTE: If the denominator divides into the numerator evenly, then the answer is expressed as a whole number.)

   Example: 9/3 = 3

10. Reducing fractions--Divide the numerator and denominator by the same whole number (Assignment Sheet # 18)

    (NOTE: A fraction is in lowest terms if both the numerator and denominator cannot be divided by the same whole number, except one.)

4.3 Fractions (Continued)

Examples: 4/6 is not reduced to lowest terms because both the numerator (4) and the denominator (6) can be divided by 2

$4 \div 2 = 2$
$6 \div 2 = 3$

$4/6 = 2/3$

2/3 is reduced because the numerator (2) and the denominator (3) cannot be divided by the same number, except 1

11. Place value in the number 0.487613

A. 4 means 4 tenths

B. 8 means 8 hundreths

C. 7 means 7 thousandths

D. 6 means 6 ten-thousandths

E. 1 means 1 hundred-thousandths

F. 3 means 3 millionths

Examples:

	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
0.	9	2	7	1	0	5

4.4 Decimals

1. Decimal notation for fractions (Assignment Sheet # 19)

A. Fractions with ten or a power of ten as the denominator may be easily written as decimals

B. There will be as many decimal places as zeros in the denominator

4.4 Decimals (Continued)

C. Place a decimal point in front of the numerator and leave off the denominator

(NOTE: Zeros may be needed as place holders.)

Examples: 1/10 = 0.1; 3/100 = 0.03; 79/100 = 0.79

D. Mixed numbers will be written with the whole number to the left of the decimal point

Examples: 1 1/10 = 1.1; 3 7/100 = 3.07

2. Number words as decimal numbers (Assignment Sheet # 20)

A. Fractions

1. Write out the number

2. Count the number of decimal places for the place value written at the end of the number word

3. Add zeros for place holders

Example: Eight hundred twenty-five ten-thousandths = 0.0825 (ten thousandths = 4 places)

B. Mixed numbers

1. Word and or the word point indicates the decimal point

2. Number words before and or point are whole numbers

3. Number words after and or point are decimal fractions

Examples: Six and one hundred twenty-five thousandths = 6.125

Seven point three eight one = 7.381

3. Rounding a decimal to a given place (Assignment Sheet # 21)

A. Consider the digit in the place immediately to the right of the given place

B. If the digit in the place to the right of the given place is less than 5, drop it and leave the other digits unchanged

4.4 Decimals (Continued)

C. If the digit in the place to the right of the given place is 5 or greater, drop it but increase the preceding digit by 1

Examples: 5.6 rounded to nearest whole number would be 6

0.52 rounded to nearest tenth would be 0.5

0.377 rounded to hundredths would be 0.38

0.7456 rounded to thousandths would be 0.746

4. Adding decimals (Assignment Sheet # 22)

A. Write the given numbers in a column with the decimal points directly under each other

B. Add each column of numbers the same as for regular whole numbers

C. Locate the decimal point in the answer by placing it directly under the above decimal points

Example: 0.857 + 2.1 + 370.057 + 753 = 1126.014

0.857	0.857
2.1	2.100
370.057	370.057
+753	+753.000
1126.014	1126.014

(NOTE: Zeros can be added so each number has the same amount of decimal places.)

5. Subtracting decimals (Assignment Sheet # 23)

A. Solving subtraction problems

1. Write the given numbers so that the decimal points are under each other

(NOTE: Whole numbers, such as 7 or 27, have understood decimal points, such as 7.00 or 27.00.)

2. Subtract each column of numbers the same as for regular whole numbers

3. Locate the decimal point in the answer (difference) by placing it under the above decimal points

4.4 Decimals (Continued)

B. Checking subtraction problems

1. Add the answer and the number just above it

2. Notice that the sum must be the same as the top number in the problem for the difference to be correct

Example:

$$\begin{array}{r} 8.120 \\ -1.397 \\ \hline 6.723 \end{array}$$

Check

$$\begin{array}{r} 1.397 \\ +6.723 \\ \hline 8.120 \end{array}$$

(NOTE: If you have a whole number, you may add as many zeros to the right of the decimal point as you need.)

6. Multiplying decimals (Assignment Sheet # 24)

A. Multiply the same as with whole numbers

(NOTE: In writing the multiplication problems, the decimal points do not have to be in columns.)

B. Total the number of decimal places to the right of the decimal point in the factors being multiplied

C. Locate the decimal point by starting at the extreme right digit in the answer and counting off as many places to the left as the total of step B indicates

Examples: Multiply 27.935 by 7.07

$$\begin{array}{rl} 27.935 & 3 \text{ places} \\ \times\ 7.07 & 2 \text{ places} \\ \hline 195545 & \\ 1955450 & \\ \hline 197.50045 & 5 \text{ places} \end{array}$$

Multiply 2.31 by 0.041

$$\begin{array}{rl} 2.31 & 2 \text{ places} \\ \times\ 0.041 & 3 \text{ places} \\ \hline 231 & \\ 924 & \\ \hline 0.09471 & 5 \text{ places} \end{array}$$

7. Dividing a decimal by a decimal (Assignment Sheet # 25)

A. Count the number of digits to the right of the decimal point in the divisor

4.4 Decimals (Continued)

B. Place a caret at the end of the number

C. Count as many digits to the right of the decimal point in the dividend as you counted in the divisor

D. Place a caret after the last digit you count

(NOTE: You may need to place some zeros in the dividend to the right of the last digit.)

E. Place the decimal point in the quotient directly above the caret in the dividend

F. Divide as with whole numbers

G. Check by multiplying the quotient and the divisor

Examples:

$$0.5\overline{)0.2\underset{\wedge}{5}} \quad \begin{array}{r} 00.5 \\ \end{array}$$

check

$$\begin{array}{r} 0.5 \\ \times 0.5 \\ \hline 0.25 \end{array}$$

$$0.05\overline{)0.25_{\wedge}} \quad \begin{array}{r} 5. \\ \end{array}$$

check

$$\begin{array}{r} 0.05 \\ \times \quad 5 \\ \hline 0.25 \end{array}$$

$$0.005\overline{)0.25} \text{ becomes } 0.005\overline{)0.250_{\wedge}} \quad \begin{array}{r} 50. \\ \end{array}$$

check

$$\begin{array}{r} 0.005 \\ \times \quad 50 \\ \hline 0.250 \end{array}$$

8. Dividing a whole number by a decimal (Assignment Sheet # 26)

A. Place a decimal point in the dividend at the right side of the number

B. Count the number of digits to the right of the decimal point in the division

C. Place a caret at the end of the number

D. Write as many zeros after the decimal point in the dividend as you counted places in the divisor

E. Place a caret after the last zero

F. Place a decimal point in the quotient directly above the caret in the dividend

4.4 Decimals (Continued)

G. Divide as with whole numbers

(NOTE: Zeros may need to be added beyond the caret if the division does not come out even.)

H. Check by multiplying the divisor and quotient

Example: $0.03\overline{)\ 9}$ becomes $0.03\overline{)\ 9.00}$ $\quad 300.$

check

$$\begin{array}{r} 300 \\ \times 0.03 \\ \hline 9.00 \end{array}$$

9. Writing fractions as decimals and percents (Assignment Sheet # 27)

A. Fractions as decimals--Divide the numerator by the denominator

Example: 5/8

$$\begin{array}{r} 0.625 \\ 8\overline{)5.000} \\ 48 \\ \hline 20 \\ 16 \\ \hline 40 \\ 40 \\ \hline \end{array}$$

B. Fractions as percents

1. Express the fraction in decimal form
2. Move the decimal point two places to the right
3. Place the percent symbol (%) after the number

Example: 7/33

$$\begin{array}{r} .2121 \\ 33\overline{)7.0000} \\ 66 \\ \hline 40 \\ 33 \\ \hline 70 \\ 66 \\ \hline 40 \\ 33 \\ \hline 7 \end{array}$$

$= 0.2121 = 21.21\%$

(NOTE: Percent means that some number is being compared to 100.)

4.4 Decimals (Continued)

10. Writing percents as fractions and decimals (Assignment Sheet # 28)

A. Percents as fractions

1. Drop the percent symbol (%)

2. Place the number over 100

(NOTE: Reduce to simplest form.)

Examples: $38\% = \frac{38}{100} = \frac{19}{50}$

$$33\ 1/3 = \frac{33\ 1/3}{100} = \frac{100/3}{100} = 1/3$$

B. Percents as decimals

1. Drop the percent symbol (%)

2. Move the decimal point two places to the left

Examples: 74% = 0.74

33 1/3% = 0.33

11. Solving percent problems (Assignment Sheets # 29 and # 30)

A. Write the percent over 100

B. Write the part being considered over the whole amount

C. Write the two fractions with an equal sign between them

D. Cross multiply and solve the resulting equation

Examples: 1. 16 is what percent of 80?

$$\frac{n}{100} = \frac{16}{80}$$

80n = 1600 (Divide 80 into 1600)

n = 20%

4.4 Decimals (Continued)

2. 5% of 97.3 is what number?

$$\frac{5}{100} = \frac{n}{97.3}$$

100n = 486.5 (Divide 100 into 486.5 or move the decimal point two places to the left)

n = 4.865

3. 26 is 40% of what number?

$$\frac{40}{100} = \frac{26}{n}$$

40n = 2600 (Divide 40 into 2600)

n = 65

12. Sale prices (Assignment Sheet # 30)

A. Finding the discount

1. Write the percent over 100
2. Write the amount of discount over the original price
3. Write the two fractions with an equal sign between them
4. Cross multiply and solve the resulting equation

Example: Saw which sells for $50 is on sale at a discount of 10%. How much is being taken off the price?

$$\frac{10}{100} = \frac{n}{50}$$

100n = 500

n = $5.00

B. Finding the sale price

1. Using the discount

a. Figure the amount of discount

4.4 Decimals (Continued)

b. Subtract the discount from the original price

Example: In the previous example, the discount is $5 and the original price is $50.
$50 - $5 = $45 sale price

2. Using the percent

a. Subtract the percent of discount from 100%

b. Write this percent over 100

c. Write the sale price over the original price

d. Write the two fractions with an equal sign between them

e. Cross multiply and solve the resulting equation

Example: Saw that sells for $50 is on sale at a discount of 10%. What will you have to pay for it?

Solution:
$$\begin{array}{r} 100\% \\ -10\% \\ \hline 90\% \end{array}$$

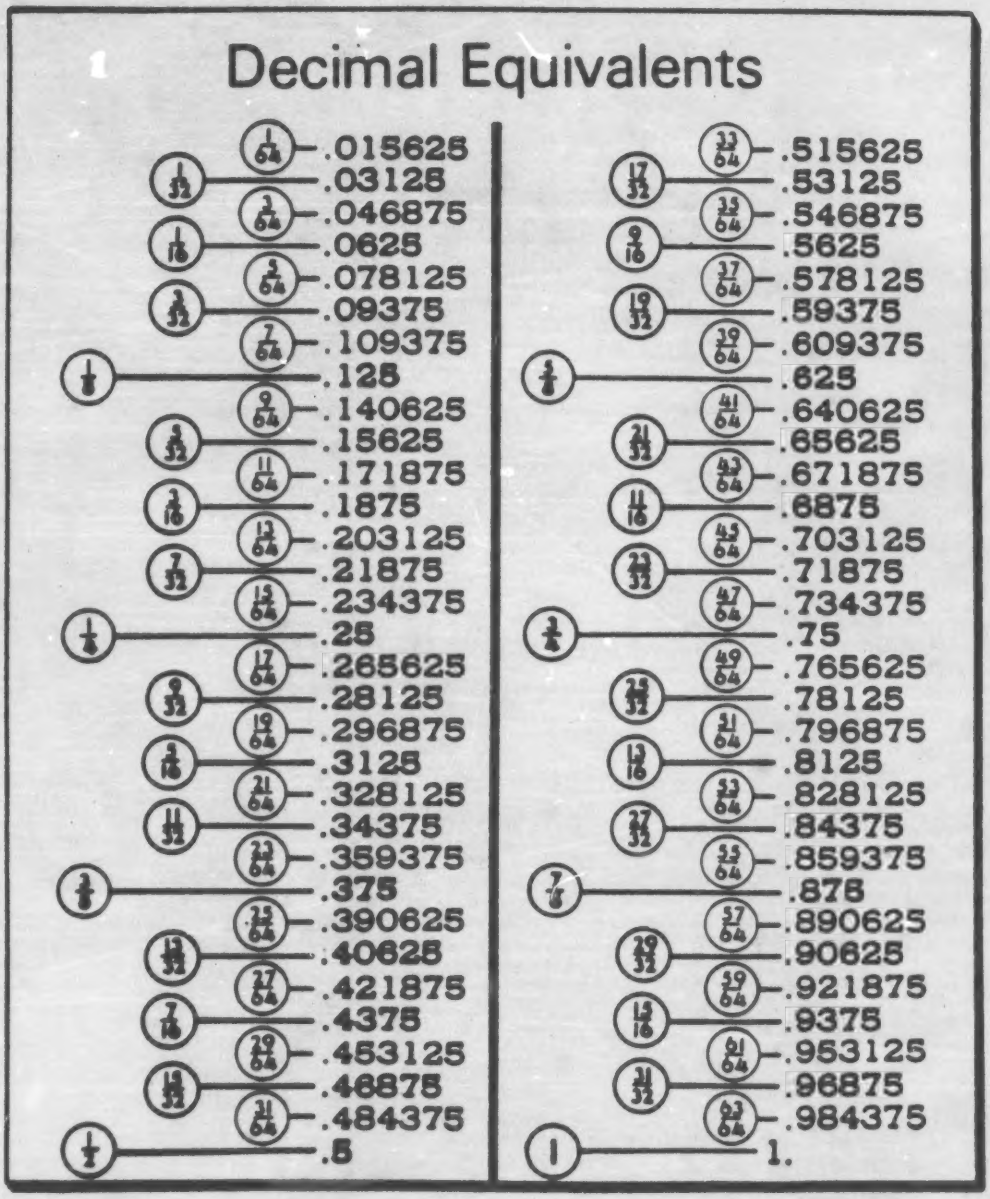
$$\frac{90}{100} = \frac{n}{50}$$

$100n = 4500$

$n = \$45.00$

4.4 Decimals (Continued)

13. Decimal and fraction equivalents



4.5 Area calculation

1. Calculate problems dealing with area (Transparency)

   Length x Width = Area

   Examples: Find the area of an object 8" wide and 10" long

   8" x 10" = 80 square inches

   Find the area of a wall 12' high and 20' long

   12' x 20' = 240 square feet

   Find the area of a wall 15'3" high and 21'9" long

   15'3" = 15.25'

   21'9" = 21.75'

   15.25' x 21.75' = 331.6875 or 331.7 square feet

2. Figuring board feet (Transparency) Assignment Sheet #31

$$\frac{\text{Number of Pieces x Thickness in Inches x Width in Inches x Length in Feet}}{12}$$

   Example: Three boards, one inch thick by six inches wide by ten feet long

$$\frac{3 \times 1" \times 6" \times 10'}{12} = \frac{180}{12} = 15 \text{ board feet}$$

   (NOTE: The answer will be incorrect if it is not labeled board feet.)

3. Computing board feet and cost (Transparency) Assignment Sheets # 31 and # 32)

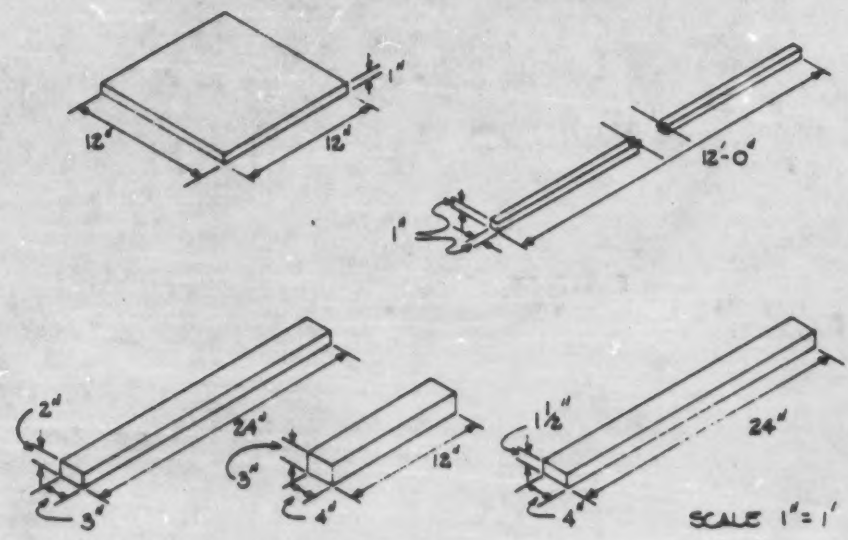
   A. Lumber sizes used in figuring board feet are the nominal sizes; lumber less than 1" thick is figured as 1 inch

      Example: Piece 1/2" x 12" x 12" is considered as one board foot. Lengths are usually in even feet under twenty-four feet; lumber over twenty-four feet can be obtained upon specification

4.5 Area calculation (Continued)

B. Unit of measure for lumber is board foot

(NOTE: Each of the illustrations is one board foot.)



C. Pricing of lumber

1. Per board foot

2. Per 100 board feet

(NOTE: Per hundred board feet is abbreviated as per C.)

3. Per 1000 board feet

(NOTE: Per thousand board feet is abbreviated as per M.)

(NOTE: Fractional board feet are not used. Round up to the nearest board foot.)

Examples: 1 1/3 board feet is called 2 board feet

1 3/4 board feet is called 2 board feet

3 1/2 board feet is called 4 board feet

4.5 Area calculation (Continued)

4. Formula for estimating concrete (Transparency)

$$\frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27} = \text{Cubic Yards of Concrete}$$

(NOTE: Thickness quite often being in inches, this has to be broken down by using fractions or decimals.)

Examples using a fraction:

$$\frac{30' \times 60' \times 4"}{27} = \frac{30' \times 60' \times 4" \text{ or } 1/3'}{27} = 22.22 \text{ cubic yards}$$

Example using a decimal:

$$\frac{30' \times 60' \times 0.33'}{27} = \frac{594}{27} = 22 \text{ cubic yards}$$

5. Procedure for estimating wire mesh (Assignment Sheet # 33)

A. Mesh roll size

1. 5' x 150'

2. 750 square feet

B. Calculate linear feet

(NOTE: Remember each row must be lapped at least six inches.)

6. Ratio and proportion as related to concrete (Transparency Assignment Sheet # 34)

A. Ratio--Indicates parts of material per mix

Example: 1 : 1 : 3 ratio means 1 part Portland cement, 1 part hydrated lime and 3 parts sand

B. Proportion--Indicates the ratio is the same but the quantity may be different

Example: 1 : 1 : 3 = 0.5 : 0.5 : 1.5 indicates the same mix but in different volumes

5.1 Builder's Level and Transit

UNIT GOALS

After completion of this unit, the student should be able to identify parts of the builder's level, and parts of transits. The student should also demonstrate the ability to set up and adjust the instruments, perform leveling jobs, and establish lines. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with the builder's level and transit to the correct definitions.
2. Identify the different types of levels.
3. Identify the parts of the builder's level.
5. Identify the fundamental parts of a transit.
6. List rules to follow in providing care of the instruments.
7. Identify hand motions used by the instrument person to guide the target person.
8. Demonstrate the ability to:
   - A. Set up and adjust the transit over a point and establish lines with two points given.
   - B. Perform a differential leveling job.

5.1 Builders level and transit

5.1.1 Terms and definitions

A. Builder's level--Instrument consisting of a telescope, leveling bubble, and tripod used primarily for establishing grade levels

B. Bench mark (BM)--Permanent point of known or assumed eleveation

(NOTE: Specific point on curb or culvert is sometimes used.)

C. Temporary bench mark (TMB)--Serves as elevation reference point

D. Fall--Pertaining to the slope of a line, such as inches of fall per foot or run

Example: 1" fall per 1' of run

E. Grade line--Proposed or future level of ground at construction line

F. Height of instrument (HI)--Vertical distance from the bench mark to the line of sight of the instrument

G. Grade stake--Stake driven into the ground locating the proposed grade

(NOTE: Read from the bench mark.)

H. Site--Plot of ground on which a project is to be constructed

I. Line of sight--Level line through the instrument as viewed by the eye; place where vertical hair crosses the horizontal hair

J. Self-reading rod--Scale on rod adjusted to height of instrument elevation and direct surface elevation and read by instrument person

K. Differential leveling--Method of leveling by which the difference in elevation between two points is determined by "+" (plus) and "-" (minus) rod readings which are totaled and adjusted to the bench mark

L. Leveling rod--Rod used in leveling with the builder's level and usually graduated in tenths and hundredths of a foot

5.1.1 Terms and definitions (Continued)

M. Transit--Instrument used for surveying; designed and used for measuring both horizontal and vertical angles

N. Surveying--Art or science of determining the area and configuration of portions of the surface of the earth

O. Plumb bob--Tool or device attached to a string; used to set and/or check the plumb or perpendicular of a surface

P. Elevation--Given grade

Q. Laser beam instrument--Automatic leveling instrument which uses a laser beam to establish elevation readings

2. Types of level (Transparencies)

A. Engineer's dumpy

B. Engineer's wild tilting

C. Turret

D. Engineer's zeiss

E. Builder's

(NOTE: The builder's level is the most practical and economical for general use and is sufficiently accurate for most purposes.)

F. Laser beam instrument

3. Types of self-reading rods (Transparency)

A. Positive reading--Gives difference in elevation between HI and elevation of the ground where shot is being taken

B. Direct reading--Adjust the rod to true elevation and any reading taken through the instrument at this point would automatically be the true elevation

4. Parts of the builder's level (Transparency)

A. Eyepiece

B. Telescope barrel

C. Focusing screw

4. Parts of the builder's level (Transparency) Continued

   D. Sun shade

   E. Bubble tube

   F. Leveling head

   G. Leveling screw

   H. Head plate

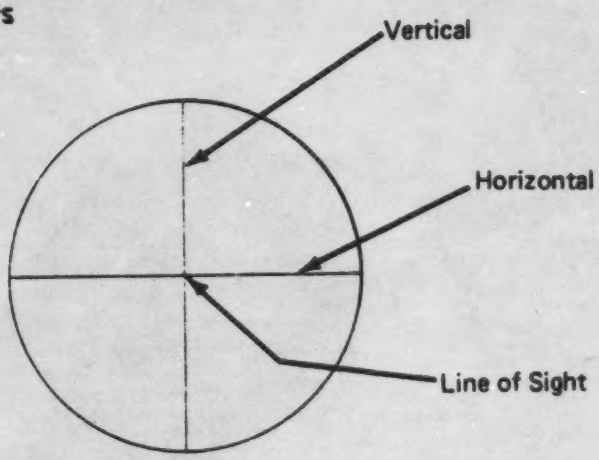
   I. Tripod

   J. Leg thumb nut

   K. Slow motion screw

   L. Clamp

5. Cross hairs



   A. Vertical

      (NOTE: This indicates direction.)

   B. Horizontal

      (NOTE: This indicates flat plane.)

   C. Line of sight

      (NOTE: This is indicated by the cross of the veritcal and horizontal hairs.)

6. Parts of leveling rod Transparency)

   A. Target face

   B. Target clamp

   C. Rod clamp

   D. Vernier scale

7. Parts of the leveling rod and their uses (Transparency)

   A. Target face--Red and white disc on rod used for certain types of readings

   B. Target clamp--Holds the target in place

   C. Rod clamp--Holds the rod when extended

   D. Vernier scale--Found on target face and rod clamp; enables reading to the nearest thousandth of a foot

8. Fundamental parts of a transit (Transparencies)

   A. Alidade

   B. Circle

   C. Leveling head

9. Specific parts of the transit (Transparency)

   A. A vernier

   B. Azimuth axis

   C. X vernier

   D. Center of half ball

   E. Elevation or horizontal axis

   F. Footplate

   G. Graduations of horizontal circle

   H. Half ball

   I. Half ring

   J. Horizontal circle (lower plate)

9. Specific parts of the transit (Transparency) Continued

   K. Inner center or alidade spindle

   L. Leveling screw

   M. Lower clamp drum contact

   N. Nub for lower clamp

   O. Outer center

   P. Plate level

   Q. Shifting plate

   R. Shoe

   S. Telescope

   T. Threads for tripod

   U. Upper clamp drum contact

   V. Upper plate

   W. Upper tangent screw for slow motion

   X. Vertical circle

   Y. Vertical-circle vernier

   Z. Window, glass

   AA. Telescope level

   BB. Vertical tangent screw for focusing on object sighted

   CC. Focusing screw for focusing on object sighted

   DD. Eyepiece focusing ring

10. Care of the instruments

   A. Protect against shock and vibration during transport

   B. Keep in case except when in use

   C. Place lens and tripod cap in box after removing from instrument

   D. Attach instrument onto tripod carefully and firmly before moving tripod

   (NOTE: Never force screws or other moving parts of an instrument)

10. Care of the instruments (Continued)

    E. Always use sun shade regardless of the weather

    F. Clean lenses with soft tissue

       (C A U T I O N: Do not clean with fingers or rough cloth. Do not remove lenses.)

    G. Loosen set screws when not in use

11. Hand motions (Transparency)

    A. Move in this direction

    B. Move up

    C. Move down

    D. Turning point

    E. Observation completed; move on; understood

    F. Come in

    G. Wrong face; check clamp; rod upside down

    H. Use long rod

    I. Wave rod from side to side

12. Reading the rod (Transparency)

    A. Large red numbers are full foot numbers

    B. Smaller black numbers are 0.1 feet (tenths of feet)

    C. Top and bottom of small black marks are 0.01 feet (hundredths of feet)

    D. Vernier scale reads 0.001 feet (thousandths of feet)

5.1.2 Set up and Adjust the Builder's Level

1. Tools and equipment

   A. Instrument

   B. Tripod

2. Procedure

   A. Grasp the two legs of the tripod that are nearest you and set the leg shoes in the ground about three feet apart

   B. Swing third leg out to form a triangle

      (NOTE: If the ground is not level, you may have to change position of tripod in order to keep head plate level. Always place two legs on downhill or unlevel side.)

   C. Tighten leg thumb nuts

   D. Check head plate to see if it is level

   E. Remove instrument from carrying case by lifting the level bar

      (CAUTION: Never grasp the telescope barrel while removing instrument from carrying case.)

   F. Attach instrument to head plate by screwing it down

      (CAUTION: Keep a firm grip on instrument until it is securely in position on tripod.)

   G. Remove dust cap from front lens

      (NOTE: The dust cap should be kept in place in order to protect the lens from dust or scratches.)

   H. Attach sun shade to the instrument

   I. Align telescope barrel directly over one pair of leveling screws

      (NOTE: The leveling screws will be used just as the name indicates, to level the instrument.)

5.1.2 Set up and Adjust the Builder's Level (Continued)

J. Rotate screws under the leveling head to bring bubble to the center of the leveling tube

(NOTE: Move your thumbs in opposite directions.)

K. Check bubble to see if it is centered

L. Turn instrument clockwise through 90 degrees to align with the other pair of leveling screws

M. Bring bubble to center of marks by rotating leveling screws

N. Turn instrument clockwise through 90 degrees to bring it parallel with first pair of leveling screws

O. Center bubble again

P. Turn instrument clockwise through 90 degrees to bring it parallel with second pair of leveling screws

Q. Center bubble again

(NOTE: Bubble should stay in center regardless of what direction the telescope is pointing. If bubble does not, instrument is out of level and should be adjusted by competent personnel.)

R. Focus cross hairs so that they appear sharp and clear

(NOTE: Focusing is accomplished by looking through the eyepiece and by turning the eyepiece ring until the cross hairs become sharp and clear.)

S. Be sure cross hairs are focused

(NOTE: The target may not be in focus.)

T. Rotate the focusing screw to bring target into sharp focus

(NOTE: When cross hairs and target are in sharp focus, you should be able to read a rod accurately. Always tie level shots back to starting bench mark to check for error in rod shots or in field notes.)

(CAUTION: After instrument is level, keep hands off tripod. Use the instrument only. If instrument creeps off level or is bumped, stop, reset tripod, relevel instrument, and start again from last known good bench mark.)

5.2 Locating the Building

UNIT GOALS

After completion of this unit, the student should be able to locate building lines from a set of datum and lay out and set batter boards and building lines. The student should also be able to square a building using the 3-4-5 rule method, the diagonal method, and the transit. This knowledge will be evidenced by completion of the job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with site layout to the correct definitions.
2. List surface aspects of the site that concern the planner.
3. List factors that are pertinent to the site layout.
4. Locate the building lines on a plot plan from a set of datum.
5. Draw the methods of squaring a building.
6. State the purpose of batter boards.
7. Demonstrate the ability to:
   - A. Erect batter boards and locate building lines.
   - B. Locate building line points on batter boards using a transit.

5.2 Locating the building

5.2.1 Terms and definitions

A. Batter boards--Temporary framework used to assist in locating corners when laying out a foundation

B. Bench mark (BM)--Metal or stone marker placed in the ground by a surveyor with the elevation indicated on it

(NOTE: The curb is sometimes used.)

C. Builder's level--Instrument consisting of a telescope, leveling bubble, and tripod used primarily for establishing grade levels

D. Transit--Instrument used for surveying; designed and used for measuring both horizontal and vertical angles

E. Plumb bob--Tool or device attached to a string; used to set and/or check the plumb or perpendicular of a surface

F. Surveying--Art or science of determining the area and configuration of portions of the surface of the earth

G. Datum--Information used as a basis for calculating or measuring

H. Excavating--Removing soil for a footing or to establish a uniform grade

I. Footing--Enlargement at the lower end of a foundation, wall, pier, or column to distribute the load

J. Grade line--Proposed or future level of ground at construction line

K. Grade stake--Stake driven into the ground that locates the finished level of the ground at that point

(NOTE: This is read from the bench mark.)

L. Leveling rod--Rod used in leveling with the builder's level and usually graduated in tenths and hundredths of a foot

M. Property lines--Boundaries of a lot or plot of ground

N. Plot plan--Drawing used to show the location and size of the structures, driveways, sidewalks, and patios on the lot

5.2.1 Terms and definitions (Continued)

O. Site--Plot of ground on which a project is to be constructed

P. Fall--Pertaining to the slope of a line, such as inches of fall per foot of run

Example: 1" fall per 1' of run

Q. Fill-Soil or other substance used to raise the grade level

R. Elevation--Given grade

S. Ledger boards--Top horizontal boards of the batter board construction

T. Saw kerf--Sawed line in which to fit string line to hold it in place

U. Plumb down--Method of plumbing from a given point down to a point below

V. Building permit--Agreement between the builder and a city that specifies the type, quality, and extent of construction to be done

W. Height of instrument (HI)--Vertical distance from the bench mark to the line of sight of the instrument

2. Surface aspects of the site that concern the planner

A. Presence of trees and shrubs

B. Contour of site

C. Elevation of site in relation to the area

D. Size, shape, and proximity of surrounding buildings

E. Soil characteristics

3. Factors pertinent to site layout

A. Local regulations (zoning regulations and restrictions)

Examples: Setback from front property line, proximity to side property lines

3. Factors pertinent to site layout (Continued)

   B. Location of services

      Examples: Sewers, electricity, gas, phone

   C. Existing trees and shrubs

   D. Shape of terrain

      Examples: Flat, rolling, sloping

4. Datum used in laying out building lines (Transparency)

   A. Dimensions of property

   B. Setback

      1. From curb

      2. From sidewalk

      3. From property line

   C. Distance from side boundaries

   D. Distance from rear of property

   E. Easements

   F. Building size

      1. Length

      2. Width

   G. Grade and location of bench mark

   H. Orientation of building on lot

      1. Square

      2. Diagonal

5. Methods of squaring a building (Transparencies)

   A. 3-4-5 rule

      (NOTE: Any multiple of the 3-4-5 rule may be used depending on the size of the building, such as 6-8-10, 12-16-20, or 24-32-40.)

5. Methods of squaring a building (Transparencies) Continued

   B. Diagonal method

   C. Transit

6. Purpose of batter boards--To provide a place of attachment for the string used to locate building lines for excavation and construction (Transparency)

7. Common errors that contribute to incorrect measurements

   A. Tape not pulled tight enough

   B. Tape not in proper alignment

   C. Plumb bob not used when measuring on slope

      (NOTE: The plumb bob is used to maintain horizontal measurements.)

   D. Reading or recording incorrect numbers (human errors)

5.3 Forming

UNIT GOALS

After completion of this unit, the student should be able to write the purpose of forms and match the external factors that affect form design to their effects. The student should be able to identify the parts and types of forms. This knowledge will be evidenced by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with forming to the correct definitions
2. Match the external factors that affect form design to their effects.
4. Identify the parts of a form.
5. Identify types of forms.

5.3 Forming

5.3.1 Terms and definitions

A. Brace-Piece of wood or other material that directs, resists, or supports weight or pressure

B. Cleat--Strip of wood or metal fastened across a form for temporary positioning or to replace a form tie

C. Duplex nail--Double-headed nail used in forming and designed for easy removal

D. Footing--Enlarged area at the base of a wall or another object used to distribute the weight of the superstructure

E. Form tie--Wire or metal crosstie used to support pressure of wet concrete and maintain proper wall thickness

F. Foundation--That portion of a wall upon which the building rests

G. Grade point--Level or finished concrete in a form

H. Key--Beveled wood or metal strip placed on the form where future pours will occur

I. Key way--Groove left in concrete by removal of key

J. Monolithic pour--Continuous mass of concrete cast as a single unit

K. Scab--Piece of material nailed across a splice to hold it together and strengthen it

L. Sheathing--Wide boards, plywood, or metal that make up the face of the form

M. Spreader--Block of wood that is used to hold the sides of the form apart and is removed as concrete is poured; may also be an integral part of the form tie

N. Spacer block--Block of wood or other material used as a spacer at offsets in a form

O. Stakes--Small boards or steel bars sharpened on one end and driven into the ground to support a form

P. Dowel--Short piece of steel bar inserted through a bulkhead to tie adjoining pours together

5.3.1 Terms and definitions (Continued)

Q. Bulkhead--Board placed in a form to cut off the concrete pour

R. Hopper--Receptacle, usually funnel-shaped, open, or with a gate at the bottom

S. Vibrator--Power tool used to consolidate concrete

T. Power buggy--Machine used to transport concrete from the mixer to the pour site

U. Form oil--Paraffin oil or other manufactured product used on a form to prevent adhesion of concrete to the form

V. Water stop--Rubber, neoprene, copper, or some composition material used to prevent passage of water through a joint

W. Reinforcing bars (rebars)--Steel bars used to strengthen concrete walls or beams

(NOTE: Rebar numbers are based on the number of 1/8 inches in the nominal diameter of the bar. A # 4 bar is 4/8" or 1/2" in diameter.)

2. Purpose of forms--To hold the wet concrete to the desired shape until it has set

3. Effects of external factors on form design

A. Slump--Greater the slump, the longer it takes concrete to set; therefore, the pressure remains on the forms for a longer period of time

B. Rate of pour--Feet of concrete depth poured in one hour

C. Temperature--Affects the rate at which hydration (set) of concrete occurs; the higher the temperature, the faster concrete sets

(NOTE: With a rate of pour of four feet per hour at 70°, the maximum pressure on the form is 550# per square foot. Using the same rate of pour at 50°, the maximum pressure increases to 750 p.s.f.)

D. Vibration--Power vibration can cause pressure to increase 35%

(NOTE: Hand spading has very little effect on pressure.)

3. Effects of external factors on form design (Continued)

   E. Method of placement--Concrete weighs 150 pounds per cubic foot; the impact of this weight on concrete already placed causes an increase in pressure on the forms; the greater the height of the drop and the mass of concrete, the greater the pressure increase

      (NOTE: High, free drops of concrete cause aggregate separation.)

   F. Size of form--Thickness and length of the wall are used to figure the rate of pour; height and width have no bearing on pressure on forms, except for the method of placement

      (NOTE: For a given rate of fill, the pressure will be the same on a four-inch-wide wall as it is on a twelve-inch-wide wall.)

   G. Types of concrete finishes

      1. Architectural concrete--Will be exposed in the finished areas of the structure; forms will be designed to give a minimum of deflection and leakage; the concrete surface may be smooth, rough, incised, sculptured, sandblasted, bush-hammered, or many other finishes

      2. Structural concrete--Will not be exposed in the finished areas of the structure, so some deflection and leakage is permissable

4. Parts of a form (Transparencies)

   A. Sheathing

   B. Brace

   C. Stake

   D. Spreader

   E. Cleat

   F. Form tie

   G. Waler

   H. Stud

4. Parts of a form (Transparencies) Continued

   I. Strongback

   J. Sole plate

   K. Bottom plate

   L. Top plate

   M. Bulkhead

   N. Key

   O. Rustication strip

   P. Chamfer strip

   Q. Spreader-washer

5. Types of forms (Transparencies)

   A. Panelized--Wood

   B. Built-in-place--Wood

   C. Patented--All metal, all wood, a combination of wood and metal or fiberglass

   D. Manufactured forms with predesigned finishes--Fiberglass and other liners

FRAMING UNIT 6

6.1 Floor and Sill Framing

UNIT GOALS

After completion of this unit, the student should be able to identify floor and sill framing members, identify the styles of framing. The student should also be able to name the methods of fastening the sill to the foundation, build a box sill and install the floor joist, list and lay the various types of subflooring, and estimate materials needed to frame a floor and sill and to lay a subfloor. This knowledge will be evidenced by completion of the assignment sheet, job sheets, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with floor and sill framing to the correct definitions.
2. Identify styles of framing.
3. Identify framing members that make up the floor and sill.
4. State the purpose of a sill sealer.
5. Name methods of fastening sills to foundation walls.
6. State the purpose of bridging.
7. Name types of bridging.
8. State the purpose of beams or girders.
9. State the purpose of joist hangers.
10. List types of subflooring.
11. Estimate the amount of material needed to frame a floor and sill and to lay a subfloor.
12. Demonstrate the ability to:
    a. Build a box sill and install a floor joist.
    b. Install bridging.
    c. Lay a subfloor.
    d. Install floor joists for cantilever floor.

6.1 Floor and Sill Framing

6.1.1 Terms and definitions

A. Balloon framing--Type of building construction in which the studs extend in one piece from the foundation to the roof

B. Beam or girder--Any large piece of timber, stone, iron, or other material used to support concentrated loads at particular points along its length

C. Bridging--Solid lumber or small wooden or steel pieces fitted in pairs from the bottom of one joist to the top of the adjacent joist and crossed to stiffen and help distribute the load

D. Crown--Relating to the high side of the crook in framing lumber

E. Foundation--Supporting portion of a structure below the first floor construction including the footings

F. Joist header--Framing member into which the common joists are fitted forming the box sill; member used to support the free end of joists over openings, such as stairs and chimneys

G. Joist--One of a series of parallel framing members used to support floor and ceiling loads and supported, in turn, by beams or girders

H. Sill--Lowest member of the frame of a structure resting horizontally on the foundation and supporting the uprights of the frame

I. Sill sealer--Resilient waterproof material used under the sills as a seal against air, dirt, and insects

J. Subfloor--Boards or panels laid directly on the floor joists over which a finished floor will be laid

K. Termite shield--Shield, usually made of sheet metal, placed on a foundation wall or around pipes to prevent the passage of termites into the structure

L. Western framing--System of framing a building where the floor joists of each story rest on the top plates of the story below, and the bearing walls and partitions rest on the subfloor of each story

6.1.1 Terms and definitions (Continued)

M. Joist hangers--Metal saddles secured to face of girder in which joist ends rest

2. Framing styles (Transparencies)

A. Western or platform framing

(NOTE: Western framing is sometimes called platform framing.)

B. Balloon framing

C. Modern braced framing

D. Framing adaptions for saving energy

3. Floor and sill framing members (Transparency)

(NOTE: Western and balloon framing styles use basically the same members.)

A. Sill sealer

B. Termite shield

C. Sill

D. Joist

E. Joist header

F. Beam or girder

G. Bridging

H. Subfloor

I. Post and Beam

J. Comparison to joist

4. Purpose of sill-sealer --Provides a seal against air, dirt, and insects (Transparency)

(NOTE: This is applied between the sill and the foundation wall.)

5. Purpose of termite shield--Prevents the passage of termites to the structure (Transparency)

(NOTE: This is applied between the sill sealer and the sill and around pipes.)

6. Methods of fastening sills to foundation walls (Transparency)

   A. Sill anchor

      (NOTE: This consists of a bolt embedded in the foundation wall that projects through the sill and provides an anchor for the sill.)

   B. Concrete nail

      (NOTE: This consists of a hardened steel nail which is driven or shot through the sill into the foundation wall.)

7. Purpose of bridging--Stiffens and helps distribute the load (Transparency)

8. Types of bridging (Transparency)

   A. Solid lumber bridging

      (NOTE: The same size material is used as for the joist and is staggered during installation to facilitate nailing.)

   B. Lumber X bridging

      (NOTE: This is usually made from 1 x 4 lumber and fitted in pairs from the bottom of one joist to the top of the adjacent joist and crossed.)

   C. Adjustable steel X bridging

      (NOTE: Steel bridging is adjustable to fit on 16" or 24" centers and should be installed according to the manufacturer's recommendations.)

9. Purpose of beams or girders--Support concentrated loads at particular points along their lengths (Transparency)

   (NOTE: These may be any large piece of timber, stone, iron, or other material used to span an open area upon which the floor joists rest.)

10. Purpose of joist hangers--Support the ends of the joist (Transparency)

11. Types of subflooring (Transparencies)

    (NOTE: Before subflooring is installed all plumbing, heating, and air conditioning rough-in work should be done.)

11. Types of subflooring (Transparencies) (Continued)

A. Lumber

(NOTE: One-inch lumber is usually placed at a diagonal across the joist.)

B. Plywood

(NOTE: Usually 5/8" x 4' x 8' CD, exterior grade, fir plywood is recommended.)

12. Fasteners (Transparency)

A. Sill anchors--Used to anchor the sill to the foundation

B. Masonry nails--Used to anchor the sill to the foundation

C. Box nails

1. 16d box nails--Used to fasten joist to sill and headers to joist

2. 8d box nails--Used to fasten subfloor to joist

13. Material estimating

(NOTE: See building specifications for kinds and dimensions of material.)

A. Sill sealer--Linear feet

(NOTE: Obtain enough to cover all foundation surfaces.)

B. Termite shield--Linear feet

(NOTE: This shield usually consists of twenty-six gauge galvanized material approximately 12" wide covering all foundation surfaces.)

C. Sill-Board feet

(NOTE: The sill may be 2 x 4 or 2 x 6. Obtain enough to cover all foundation surfaces.)

D. Beams or girders--Board feet

(NOTE: Material must be of sufficient strength to carry the expected load, including enough to span allareas where required. See specifications.)

13. Material estimating (Continued)

E. Joists--Board feet

1. Determine length needed from foundation plan and round up to the nearest even foot

2. Determine the number of joists needed

a. For 16" on center

1) Multiply length of building by 3/4

2) Add one joist for the end

(NOTE: Add one joist for each partition that runs parallel to the joists.)

b. For 24" on center

1) Multiply length of building by 1/2

2) Add one joist for the end

(NOTE: Add one joist for each partition that runs parallel to the joists.)

F. Joist headers--Board feet

(NOTE: Allow enough for twice the length of the building and all openings.)

G. Bridging

(NOTE: One row of bridging is required in spans over 8' in length and less than 16'. Two rows of bridging are required in spans over 16'.)

1. Wood X bridging -- Board feet

(NOTE: Bridging usually consists of 1 x 4 rough lumber.)

a. Determine the number of rows of bridging needed

b. Determine the length of each row of bridging

13. Material estimating (Continued)

c. Multiply the sum of all the row lengths in lineal feet by the appropriate factor from the following table to get the total lineal feet of bridging needed for the job

Joist Size	Spacing, In. O.C.	Lineal Feet of Material Per Foot of Bridging Row
2 x 6 to 2 x 10	16	2
2 x 12	16	2 1/4
2 x 14	16	2 1/2

(NOTE: If the joists are 24" on center, the total lineal footage of bridging rows is equal to the number of pieces of bridging material needed.)

2. Steel bridging--Number of each for joists 16" on center

a. Determine the number of rows of bridging needed

b. Determine the length of each row of bridging

c. Multiply the total lineal footage of bridging rows by 3/4 to find the number of spaces between joists 16" on center

d. Multiply the above total by two to determine the number of pieces of bridging required

(NOTE: If the joists are 24" on center, the total lineal footage of rows is equal to the number of pieces of metal bridging needed.)

3. Solid lumber bridging

a. Determine the number of rows of bridging needed

b. Determine the length of each row of bridging

c. Multiply the number of rows by the length of each row to determine the total lineal feet of bridging needed

13. Material estimating (Continued)

H. Subflooring

1. Lumber--Board feet

(NOTE: Lumber recommended is usually 1 x 6 or 1 x 8 and may be laid diagonally or at right angles to the joist.)

a. Calculate the area of the entire floor to be covered ignoring small openings in the floor

(NOTE: Length times width equals area.)

b. Calculate the amount of material that must be allowed for waste by using the following table and add to the total area

Material	Allowance When Laid at Right Angles to Joists, %	Allowance When Laid Diagonally, %
1 x 6 tongued and grooved	20	25
1 x 8 tongued and grooved	15	20
1 x 6 shiplap	20	25
1 x 8 shiplap	15	20
1 x 6 square edge	12	17
1 x 8 square edge	10	15

(NOTE: A rule of thumb is that for 1 x 6 lumber add to the total area 1/6 for waste and for 1 x 8 lumber add 1/8.)

2. Plywood--Square feet or number of pieces

(NOTE: Usually 5/8" x 4' x 8' plywood is recommended.)

a. Calculate the entire floor area

(NOTE: When laid at right angles to the joist, the waste is negligible.)

b. Divide the square feet of area by 32 and round up to the next whole number to determine the number of pieces needed

13. Material estimating (Continued)

I. Nails--Pounds

1. 16d box for joists--10 pounds per 1,000 board feet

2. 8d box

a. For bridging--2 pounds per 100 lineal feet

b. For lumber subfloor--32 pounds per 1,000 board feet

c. For plywood subfloor--10 pounds per 1,000 square feet

6.2 Walls and partitions

UNIT GOALS

After completion of this unit, the student should be able to identify framing members and compute the length of common members. The student should also be able to lay out, cut, and assemble a wall section and name and install types of sheathing. This knowledge will be evidenced by comletion of the assignment sheet, job sheets, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match a list of terms associated with wall and partition framing to the correct definitions.
2. Identify the framing members used in wall and partition construction.
3. Compute the length of the regular stud.
4. Compute the length of trimmers for window and door openings.
5. Compute the length of the rough header for windows and doors.
6. Name types of sheathing.
7. Estimate the amount of materials needed for wall and partition framing.
8. Demonstrate the ability to:
   a. Lay out wall and partition locations on floor.
   b. Cut studs, trimmers, cripples, and headers to length.
   c. Build corners, T's, and headers.
   d. Construct wall sections for a single-story structure.
   e. Install sheathing.
   f. Lay out and install ceiling joists.

SPECIFIC OBJECTIVES (Continued)

g. Install windows.

h. Install exterior door frame and hang door.

6.2. Walls and partitions

1. Terms and definitions

A. Bearing wall--Wall which supports the floors and/or roof directly above it in addition to its own weight

B. Blocking--Use of wood blocks as filler pieces between framing members

C. Cripple stud--Any part of a framing stud that is cut less than full size, as over a door or window opening and under a window opening

D. Double plate--Topmost member of a wall section attached to the top of the studs for the purpose of stiffening the wall and for tying together splices, corners, and partitions that are at right angles to a wall

E. Header--Horizontal structural member that supports the load over an opening, such as a window or door

F. Partition--Wall that subdivides space within a building

G. Rough opening--Opening for doors and windows formed by the framing members

H. Rough sill--Lower framing member which is attached to the top of the bottom cripple studs and forms the base of a rough opening for a window

I. Sole plate--Lowest horizontal member of a wall or partition which rests on the rough floor to which the studding is nailed

J. Stud--Main vertical framing members in walls and partitions

K. Trimmer--Vertical members that form the sides of a rough opening for a door or window upon which the header rests

L. Jamb--Top and two sides of a door or window frame which contact the door or sash, consisting of a head jamb and two side jambs

M. Spacer--Usually a 2 x 4 about 16" long used as a spacer between studs to form corners and partition T's

N. Gable--End of building; triangular end of an exterior wall above the eaves

1. Terms and definitions (Continued)

   O. Bearing partition--Partition wall that supports the structure above

   P. Sheathing--Various types of material designed to use on exterior of a structure

2. Wall and partition framing members (Transparency)

   A. Sole plate

   B. Regular stud

   C. Top plate

   D. Trimmer stud

   E. Header

   F. Cripple stud

   G. Rough sill

   H. Double top plate

   I. Corner assembly

   J. Blocking

3. Computing the length of the regular stud

   A. Slab floor (Transparency)

      1. Determine the height of the finished ceiling from the finished floor including one-half inch clearance for finish material

      2. Determine the thickness of the sole plate plus the double top plate

      3. Determine the thickness of ceiling material and flooring material

         (NOTE: For carpet or a resilient type flooring material, the thickness is negligible.)

      4. Add the thickness of ceiling and flooring material to the finished ceiling height

3. Computing the length of the regular stud (Continued)

5. Subtract the thickness of the plates from the sum achieved in step number four for the stud length

Example: When the desired finished ceiling height is 8'-1/2" the actual plate thickness is 1 1/2", and the ceiling thickness is 1/2"

Step # 1--Finished ceiling height = 8' + 1/2" = 8'-1/2"

	Sole Plate		Top Plate		Double Top Plate
Step # 2--	1 1/2"	+	1 1/2"	+	1 1/2" = 4 1/2"
	Finished Ceiling Height				Thickness of Ceiling
Steps # 3 and 4--8'-1/2"				+	1/2" = 8'-1"

Step # 5-- 8'-1" - 4 1/2" = 7'-6 1/2" Stud Length

B. Wood floor

1. Determine the height of the finished ceiling from the finished floor including 1/2" clearance for finish material

2. Determine the thickness of the sole plate plus the double top plate

3. Determine the thickness of ceiling material and underlayment

4. Add the thickness of ceiling and underlayment to the finished ceiling height

5. Subtract the thickness of the plates from the sum achieved in step number four for the stud length

Example: When the desired finished ceiling height is 8'-1/2", the actual plate thickness is 1 1/2", the ceiling thickness is 1/2", and the underlayment thickness is 5/8"

Step # 1--Finished ceiling height - 8'-1/2"

	Sole Plate		Top Plate		Double Top Plate
Step # 2--	1 1/2"	+	1 1/2"	+	1 1/2" = 4 1/2"

3. Computing the length of the regular stud (Continued)

	Finished Ceiling Height		Thickness of Ceiling Material		Thickness of Underlayment	
Step # 3 and # 4--	8'-1/2"	+	1/2"	+	5/8"	= 8'-1 5/8"

Step # 5-- 8'-1 5/8" - 4 1/2" = 7'-9 1/8" Stud Length

4. Computing the length of trimmers for window and door openings (Transparency)

(NOTE: The tops of all windows and doors should be the same height from the floor unless otherwise specified. To compensate for variation in materials, the top of the trimmers may be scribed.)

A. Slab floor

1. Determine the height of the rough opening from the finished floor

2. Determine the door height and add 5/8" for clearance at the bottom of the door

(NOTE: Standard doors are 6'-8" high.)

3. Add 3/4" for jamb header

4. Add 3/4" for clearance between rough header and jamb header

5. Subtract the thickness of the sole plate and the result is the trimmer stud length

Example:			
	Door height and clearance	6'-8"	5/8"
	Jamb header		3/4"
	Header clearance		3/4"
		6'-10	1/8"
	Sole plate	1	1/2"
	Trimmer stud length	6'- 8	5/8"

B. Wood floor--Compute the same as for a slab floor remembering to add the thickness of the underlayment to establish the finished floor

(NOTE: To compensate for variation in materials, the top of the trimmers may be scribed.)

5. Computing rough header length for window and door openings (Transparency)

   A. Rough header length for doors

      (NOTE: If prehung doors are used, check manufacturer's specifications for rough opening size.)

      1. Determine rough opening width

      2. Check door schedule for door sizes

      3. Add 1/4" to door width for clearance between door edges and jamb

      4. Add 1 1/2" for side jambs

      5. Add 1" for clearance to install jambs

      6. Add 3" to rough opening width for trimmer studs to get the header length

         Example: For a 3'-0" x 6'-8" door

Door size	3'-0"	
Door and jamb clearance		1/4"
Side jambs	1	1/2"
Side jamb and trimmer clearance	+ 1"	
Rough opening	3'-2	3/4"
Thickness of trimmer studs	+ 3"	
Header size	3'-5	3/4"
	or 41	3/4"

      (NOTE: After computing one header size, subtract the door size from it and use this figure to add to other door sizes to determine header sizes.)

   B. Rough header length for windows--Check with manufacturer to determine rough opening size and add the thickness of the two trimmer studs, also taking into account whether the return on metal windows is to be sheetrock or wood

6. Types of sheathing (Transparencies)

   A. Gyplap

   B. Fiberboard

   C. Plywood

   D. Styrofoam

6. Types of sheathing

   E. 1 x 6's (diagonal, horizontal, or vertical)

7. Estimating amount of materials needed for wall and partition framing

   A. Wall plates (2 x 4)

      (NOTE: Plate material is usually ordered in sixteen-foot lengths.)

      1. Determine the lineal footage of all outside walls, including openings

      2. Determine the lineal footage of all inside walls, including partitions and openings

      3. Multiply the total, inside and outside lineal footage, by three

         (NOTE: There are three plates: sole plate, top plate, and double top plate.)

      4. Divide the total lineal footage obtained in step number three by sixteen and round up to the next full number to get the number of sixteen-foot 2 x 4's needed for plates

   B. Studs 16" on center

      (NOTE: Studs may be purchased precut or cut on the job from eight-foot or sixteen-foot 2 x 4's.)

      1. Determine the lineal footage of all outside and inside walls

      2. Allow one stud for each lineal foot of wall

      3. If sixteen-foot material is used, divide the total achieved in step number one by two for the number of sixteen-foot 2 x 4's needed for studs

      4. On buildings with gable roofs use one-half the plate length for determining the number of gable studs needed at each gable end

         a. Multiply one-half the plate length by three-quarters if the gable studs are 16" centers to determine the number needed

7. Estimating amount of materials needed for wall and partition framing (Continued)

b. Determine to the nearest whole foot the length of the longest gable stud from the double plate to the top of the roof

(NOTE: One piece of stud material will make a long and a short gable stud; this is why only one-half of the plate length is used.)

C. Headers

(NOTE: The use of 2 x 12 headers requires more material, but the time saved more than makes up for the difference.)

1. From the door and window schedule determine size of all doors and windows

(NOTE: List each door and window separately.)

2. Add six inches to each door and window rise

3. Double the length for each door and window

4. Combine lengths obtained in step number three into convenient lengths for ordering and to minimize waste

5. Order a bundle of laths or a sheet of 1/2" C-D plywood to cut up for spacers

D. Diagonal bracing (if used)

(NOTE: Diagonal bracing is required at each end of all exterior walls. These braces run from top to bottom plate at an approximate angle of 45°. Walls 8'-0" high would require material twelve-feet long for each brace.)

1. Determine the number of outside and inside corners in the exterior walls

2. Multiply the number of corners by two to determine the number of twelve-foot 1 x 6's needed for bracing

E. Wall sheathing (8-foot wall)

1. Plywood

7. Estimating amount of materials needed for wall and partition framing (Continued)

   a. Determine the lineal footage of all outside walls

      (NOTE: If there is a gable end, add one-half of the width of each gable to the total lineal footage of the outside walls.)

   b. Multiply the total lineal footage by eight to determine the total square feet of wall area

   c. Divide the square feet of wall area by thirty-two (the number of square feet in a sheet of plywood) and round up to the nearest whole number to determine the number of sheets of 4' x 8' plywood needed for sheathing

2. Gyplap

   a. Determine the lineal footage of all outside walls

      (NOTE: If there is a gable end, add one-half of the width of each gable to the total lineal footage of the outside walls.)

   b. Multiply the total lineal footage by eight to determine the total square feet of wall area

   c. If let-in bracing is used, divide the total square feet of wall area by sixteen (the square feet in a piece of gyplap) and round up to the next whole number to determine the number of pieces of gyplap needed for sheathing

   d. If plywood bracing is used, determine the number of inside and outside corners to be braced and multiply by four (the equivalent to the number of pieces of gyplap it replaces) and subtract this figure from the total number of pieces in Step c to get the number of pieces of gyplap needed for sheathing

   e. Multiply the number of inside and outside corners by two to determine the number of pieces of plywood needed for bracing

7. Estimating amount of materials needed for wall and partition framing (Continued)

3. Fiberboard

a. Determine the lineal footage of all outside walls

(NOTE: If there is a gable end, add one-half of the width of each gable to the total lineal footage of the outside walls.)

b. Multiply the total lineal footage by eight to determine the total square feet of wall area

c. If let-in bracing is used, divide the total square feet of wall area by thirty-two (the square feet in a piece of fiberboard) and round up to the next whole number to determine the number of pieces of fiberboard needed for sheathing

d. If plywood bracing is used, determine the number of inside and outside corners to be braced and multiply by two (the number of pieces of fiberboard to be replaced at each corner) and subtract this figure from the total of pieces in Step c to get the number of pieces of fiberboard needed for sheathing

e. Multiply the number of inside and outside corners by two to determine the number of pieces of plywood needed for bracing

4. Styrofoam--Will take the same amount of material as fiberboard

F. Ceiling joist on sixteen-inch centers

1. Determine the size of joists needed from specifications

2. Determine the length of the longest wall

3. Number of ceiling joists needed equals wall length x 3/4 + 1

(NOTE: A building greater than sixteen-feet wide will require a combination of lengths of joists.)

7. Estimating amount of materials needed for wall and partition framing (Continued)

G. Nails

(NOTE: Use the table below for an estimate of the nails needed for a particular application.)

Application	Nail Size and Type	Amount
Wall Framing	8d box 16d box	2 lb. per 1000 bd. ft. 8 lb. per 1000 bd. ft.
Ceiling Framing	16d box	4 lb. per 1000 bd. ft.
Wall Sheathing Fiberboard 25/32"	8d box	30 lb. per 1000 sq. ft.
Fiberboard 1/2"	2" barbed roofing	15 lb. per 1000 sq. ft.
Gyplap 1/2"	1 1/2" barbed roofing	12 lb. per 1000 sq. ft.
Plywood 1/2"	6d box	10 lb. per 1000 sq. ft.
Styrofoam	1 1/2" roofing	12 lb. per 1000 sq. ft.

H. Exterior doors (excluding overhead)

1. Determine the number of exterior jambs needed and the size

   a. With sills

   b. Without sills

2. Determine types and sizes of doors needed

   (NOTE: This information usually can be obtained from the specifications and door schedule.)

6.3 Roof framing

UNIT GOALS

After completion of this unit, the student should be able to identify the roofing members and roof styles and list the methods for determining rafter length. The student should be able to cut and assemble the various roof members and apply roof sheathing. This knowledge will be evidenced by completion of the assignment sheets, job sheets, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with roof framing to the correct definitions.
2. Identify roofing members.
3. Identify roof styles.
4. Match roof framing units to their descriptions.
5. List methods for determining the length of a rafter.
6. Compute the length of a common rafter using the framing square.
7. Compute the length of a hip rafter using the framing square.
8. Compute the length of jack rafters using the difference in length tables on the framing square.
9. Estimate the material needed to frame a roof.
10. Demonstrate the ability to:
    a. Lay out rafter locations on the plate and ridge on two-foot centers.
    b. Lay out, cut, and erect rafters.
    c. Apply roof sheathing.

6.3 Roof framing

1. Terms and definitions

A. Barge rafter--Exposed rafter at the end of a gable roof; sometimes called a verge rafter

B. Birdsmouth--Cutout near the bottom of a rafter which fits over the double plate

C. Collar beam--Horizontal tie beam connecting two opposite rafters up near the ridge to hold them together at the ridge

D. Common rafter--One of a series of rafters extending from the double plate to the ridge

E. Dormer--Vertical window in a roof

F. Gusset--Panel or bracket of either wood or metal attached to the corners of intersections of a frame to add strength and stiffness

G. Hip rafter--Rafter extending from the double plate at the corner of a structure to the ridge, forming the angle for a hip roof

H. Jack rafter--Short rafter which fits between the plate and the hip or valley rafter or between the ridge and hip or valley rafter

(NOTE: When fitted between hip and valley rafter, it is called a cripple jack.)

I. Pitch--Angle or degree of slope of a roof

J. Plumb cut--Cut at right angles to the seat cut of the birdsmouth; cut of the rafter at the ridge

K. Purlin--Horizontal timbers supporting the common rafters in roofs

L. Ridge board--Horizontal member or timber at the top of the roof to which the upper end of the rafters are nailed

M. Rise--Incline or pitch of a roof expressed in terms of inches per one foot of run

N. Run--Horizontal distance that underlies the slope of the roof from a wall to the ridge, usually one-half of the span

1. Terms and definitions (Continued)

   O. Seat cut--Cut at the lower end of a rafter; the part of the birdsmouth that rests on the plate

   P. Span--Horizontal distance that underlies the roof from outside of one exterior wall to outside of opposite exterior wall

   Q. Valley rafter--Rafter used in an internal angle of a roof to form a valley

2. Roofing members (Transparency)

   A. Collar beam

   B. Common rafter

   C. Hip rafter

   D. Ridge board

   E. Valley rafter

   F. Gable stud

   G. Hip jack

   H. Valley jack

   I. Overhang

   J. Plate

3. Roof styles (Transparency)

   A. Gable

   B. Hip

   C. Shed or lean-to

   D. Flat

   E. Gable and dormer

   F. Mansard

   G. Gambrel

4. Roof framing units

   A. Unit span--Always equals twenty-four inches

   B. Unit rise--Changes with slope or pitch

   C. Unit run--Always equals twelve inches

   D. Unit length--Increases with rise

5. Methods for determining rafter length (Transparencies)

   A. Framing square step-off method

   B. Rafter tables from framing square

      (NOTE: Rafter tables are usually in length per foot of run although some tables are in length per given run.)

6. Computing the length of a common rafter using the framing square

   (NOTE: Refer to fold-out of framing square at end of information sheet.)

   A. Determine the common rafter layout--Measure from the outside of the plate on one side wall to the outside of the plate on the opposite side wall (Transparency 5)

   B. Determine the run of the common rafter

      (NOTE: Run equals one-half of span.)

      1. Divide the span by two

      2. Subtract one-half the thickness of the ridge board

         (NOTE: This is commonly called shortening.)

   C. Determine the pitch of the roof or the rise per foot of run

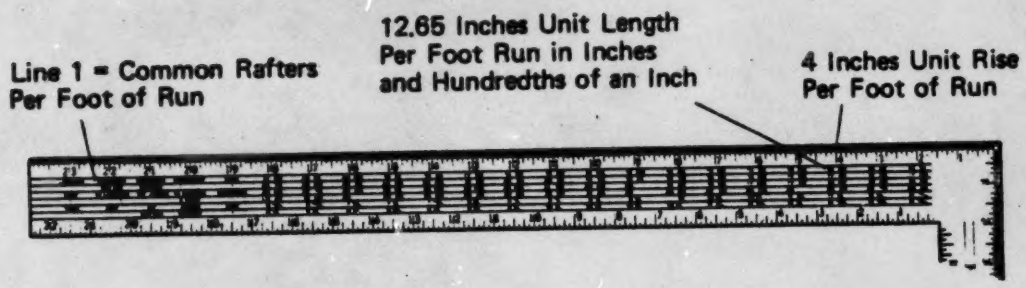
   D. Read the length of the rafter per foot of run from framing square

      (NOTE: Refer to framing square at end of information sheet.)

      1. Locate the unit rise per foot of run on the blade of the framing square

6. Computing the length of a common rafter using the framing square (Continued)

Example: If the unit rise is four inches per one foot of run, locate the number four on the edge of the blade


Line 1 = Common Rafters Per Foot of Run
12.65 Inches Unit Length Per Foot Run in Inches and Hundredths of an Inch
4 Inches Unit Rise Per Foot of Run

2. Read the figure under the unit rise for the unit length per foot of run for the common rafter

(NOTE: In the illustration, this figure is 12.65 inches per foot of run)

3. Multiply the unit length per foot of run by the actual run

Example: If the run of the building for the illustration given is ten feet, multiply 10 x 12.65 = 126.50 inches or 10 54/100 feet or 10'-6 1/2". This is the length of the common rafter. The formula for this procedure is:

$$\frac{\text{Feet of Run} \times \text{Inches Per Foot of Run}}{12"}$$

(NOTE: The following table may be used to convert decimals to inches.)

1 inc equals 0.083 foot
2 inches equals 0.167 foot
3 inches equals 0.250 foot
4 inches equals 0.333 foot
5 inches equals 0.417 foot
6 inches equals 0.500 foot
7 inches equals 0.583 foot
8 inches equals 0.667 foot
9 inches equals 0.750 foot
10 inches equals 0.833 foot
11 inches equals 0.917 foot

7. Computing the length of a hip rafter using the framing square

   A. Determine the span, run, and rise the same as for the common rafter

   B. Read the length of the hip or valley rafter per foot of run from the framing square

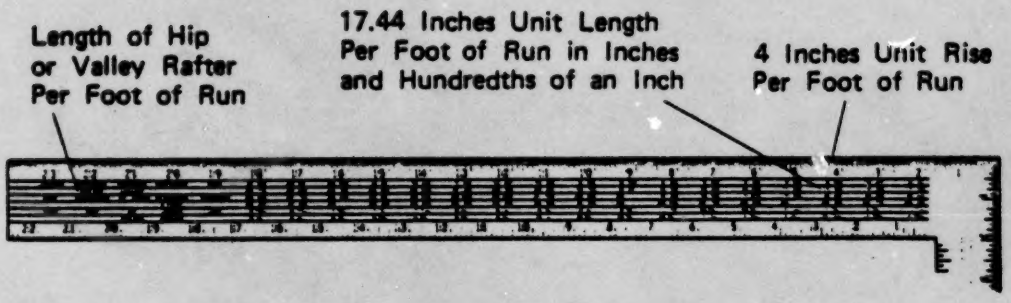
      (NOTE: Refer to framing square at end of information sheet.)

      1. Locate the unit rise per foot of run on the blade of the framing square the same as for a common rafter

         (NOTE: See the illustration for common rafters on the preceeding page.)

      2. Read the figure under the unit rise for the length of hip or valley rafters per foot of run of common rafter

         (NOTE: See the illustration below for the inches in rise per foot of run for a hip or valley with a four-inch rise per foot of run.)


Length of Hip or Valley Rafter Per Foot of Run
17.44 Inches Unit Length Per Foot of Run in Inches and Hundredths of an Inch
4 Inches Unit Rise Per Foot of Run

      3. Determine the length of the hip or valley rafter by multiplying the unit length per foot of run by the feet of run and divide by twelve, the same as for the common rafter

         (NOTE: Use the same formula as in computing the common rafter as shown in the illustration.)

$$\frac{\text{Inches Per Foot Run} \times \text{Feet of Run of the Common Rafter}}{12"}$$

$$\frac{17.44 \times 10}{12} = \frac{174.4}{12} \text{ inches}$$

7. Computing the length of a hip rafter using the framing square (Continued)

   174.4 inches = 14'-6 3/8" length of hip or valley rafter; shorten by one-half the diagonal thickness of the ridge board

8. Computing the length of jack rafters using the framing square

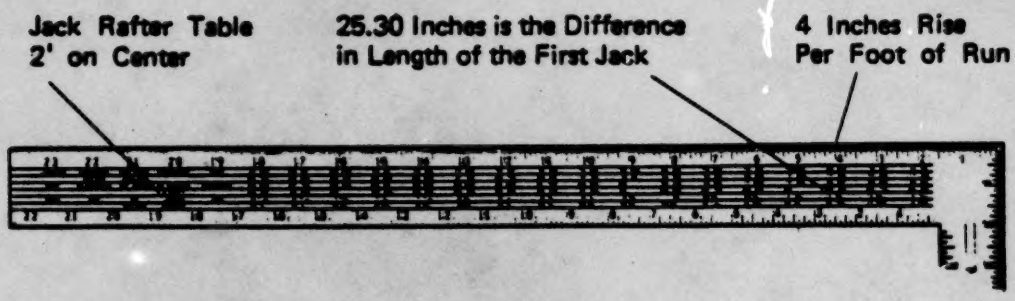
   (NOTE: The rise per foot of run is the same as for common rafters.)

   A. Locate the table for jacks on two-foot centers on the blade of the framing square

      (NOTE: Refer to framing square at end of information sheet.)

   B. Locate the rise per foot of run on the edge of the blade

   C. Read across and down to the number listed



   D. For a roof of four inches rise per foot of run, the length of the first jack rafter from the table is 25.30 inches or 25 3/8" shorter than the common rafter

   E. Second jack will be two times shorter than the first jack or 50 3/4" shorter than the common rafter

   F. Third jack will be three times shorter than the first jack or 76 1/8" shorter than the common rafter

   G. Fourth jack will be four times shorter than the first and fifth will be five times shorter and continued until the number needed is reached

9. Estimating roof framing materials

A. Gable roof with rafters two feet on center

1. Rafters--For a simple rectangular building

a. Determine the length of the rafter, including overhang

(NOTE: Refer to Transparency or framing square at end of information sheet.)

b. Determine the number needed

1) Measure the length of one side of the building and round up to the nearest foot

2) Add six additional rafters, two for end rafters and four for barge rafters

2. Ridge board (Transparency)

(NOTE: The ridge should be the next dimension longer than the rafter material.)

a. Gable roof--Determine the length of the plate on one side of the building and add the amount of projection over each gable end for a simple rectangular building

b. Hip roof

1) Measure the length of the building

2) Measure the width of the building

3) Subtract the width from the length and add the thickness of the ridge to the remainder for the actual ridge length

B. Hip roof with rafters two feet on center--Rafters for a simple rectangular building

(NOTE: Refer to Transparency or framing square on next page.)

1. Determine the length of the common rafters including overhang

2. Determine the length of the hip rafters including overhang

(NOTE: Jack rafters are simply common rafters that have been shortened.)

9. Estimating roof framing materials (Continued)

3. Determine the number of rafters needed for a simple rectangular hip roof

a. Hip rafters--One for each corner

b. Common and jack rafters--Measure the length of the building, round up to the nearest foot, and add two end rafters or four for barge rafters as in a gable roof

(NOTE: The same amount of material is needed for rafters for either a gable or hip roof.)

6.4 Trusses

UNIT GOALS

After completion of this unit, the student should be able to identify the main parts of a truss and hardware used in truss construction. The student should also be able to identify types of trusses, name methods of fabrication, and erect light frame truss for gable roof. This knowledge will be evidenced by completion of the job sheet and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with trusses to the correct definitions.
2. Identify the main parts of a truss.
3. Identify pieces of hardware used in truss construction.
4. Identify types of trusses.
5. Name methods of fabricating trusses.
6. Demonstrate the ability to erect light frame truss for gable roof.

6.4 Trusses

1. Terms and definitions

   A. Truss--Combination of members, such as top chord, bottom chord, compression webs, and tension webs, usually arranged in triangular units for a rigid framework, for supporting loads over a long span, as in bridge or roof construction

   B. Top chord--Upper member of a truss

   C. Bottom chord--Bottom member of a truss

   D. Tension web--Member connecting the top and the bottom chords in tension

   E. Compression web--Member connecting the top and bottom chords of a truss in compression

   F. Gang-nail connector plate--Steel plate from which a number of uniform nails have been stamped out to protrude at right angles from the plate itself

      (NOTE: Gang-nail connector plates are also called gang nails. Gang-nail connector plates are a patented product of ABC Inc.)

   G. Split ring--Steel ring with a tongue and grooved split in the band used to strengthen wood to wood connections in timber

      (NOTE: A groove must be cut in the timber for installation.)

   H. Toothed ring--Thin steel ring, corrugated and toothed, which is pressed into two wood members to strengthen the connection

   I. Glue-laminated timbers--Timbers built up of thin pieces of lumber glued together and sometimes sprung to desired shapes before gluing

   J. Gusset--Brace or angular bracket used to stiffen a corner or angular intersection of two or more members

   K. Component--Subdivision of a unit

   L. Component yard--Yard or mill specializing in the fabrication of components of a building

2. Main parts of a truss (Transparency)

   A. Top chord

   B. Bottom chord

   C. Tension web

   D. Compression web

   E. Gang-nail connector plate

3. Hardware used in truss construction (Transparency)

   A. Split ring

   B. Toothed ring connector

   C. Gang-nail connector plate

   D. Shear plate

   E. Machine bolt

   F. Plate washer

   G. Malleable wahsers

   H. Plywood gusset

4. Types of trusses (Transparency)

   (NOTE: Trusses can be built to fit most situations. This is a group of the most common types. All trusses may be glue-laminated.)

   A. Standard Howe truss

   B. Hip louver truss

   C. Double W truss

   D. Modified queenpost truss

   E. Bowstring truss

   F. Scissors truss

   G. Flat trusses (Howe)

   H. Flat trusses (Warren)

   I. Hip truss

5. Methods of fabricating trusses (Transparencies)

   A. Gang-nailed

      (NOTE: Trusses using this method are generally manufactured in a component yard.)

   B. Split ring connector and bolt

7.0 Roofing Materials

UNIT GOALS

After completion of this unit, the student should be able to identify the different types of roofing materials. The student should also be able to apply different types of roofing material. This knowledge will be evidenced by completion of assignment sheets, job sheets, and unit tests with a minimum of 85 percent accuracy.

SPECIAL OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms associated with roofing materials.
2. Identify types of roofing
3. Estimate for specific roofing materials.
4. Layout and apply roofing material to manufacturer's specification

INSTRUCTIONAL INFORMATION UNIT 7

7.0 Roofing Materials

1. Terms and defintions
   - A. Built-up
   - B. Cant strip
   - C. Closed valley
   - D. Flashing
   - E. Galvanized
   - F. Gravel stop
   - G. Roll roofing
   - H. Shake
   - I. Shingle
   - J. Starter course
   - K. Straight split
   - L. Strip shingle
   - M. Square
   - N. Tape split
2. Roofing materials
   - A. Shake
   - B. Shingle
   - C. Asphault
   - D. Built-up
3. Application (Transparencies)
   - A. Ideal weather conditions
   - B. Tools required
   - C. Starter strip at eave
   - D. Nail first course so it overhangs starter strip by 1/2"

3. Application (Continued)

   E. Use a rule and establish exposure

      (NOTE: 5" is standard)

   F. Trim tabs to establish start of first five courses

   G. Snap chalk line horizontally and vertically to keep roof accurate.

4. Finishing a ridge (Transparency)

5. Procedure for shingling around a pipe (Transparency)

8.0 Exterior Plywood Siding and Trim

UNIT GOALS

After completion of this unit, the student should be able to identify the styles of a cornice, the parts of a cornice, and styles of siding. The student should also be able to build a horizontal box cornice, apply wood siding, and apply plywood siding. This knowledge will be evidenced by completion of assignment sheet, job sheets, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with exterior plywood siding and trim to the correct definitions.
2. Identify styles of cornice.
3. Identify the parts of a cornice.
4. Name types of exterior wall coverings.
5. Identify styles of siding.
6. Estimate the material needed for siding and trim.
7. Demonstrate the ability to:
   a. Apply wood siding.
   b. Apply plywood siding.

8.0 Exterior Trim and Siding

1. Terms and definitions

   A. Batten--Strip of wood placed across a surface to cover joints

   B. Barge board--Trim board or fascia at the gable end of a structure and attached directly to the barge rafter

   C. Boxed cornice--Method of closing in the eave to form a box type structure using the wall of the building, the roof, the fascia, and the plancier

   D. Brick molding--Molding for exterior window and door frames against which the finished brick is laid

   E. Fascia--Flat outside horizontal member of a cornice which is attached to the rafter tails

   F. Frieze--Trim member that forms a band around the top of the wall of a structure covering the joint where the wall meets the cornice

   G. Furring strip--Flat pieces of lumber used to build up an irregular framing to an even surface for the application of flooring, ceiling, or wall covering

   H. Lookouts--Short wooden framing members attached to a ledger board at the top of the wall and to the rafter tails for attachment of the plancier

   I. Lookout ledger--Usually a 1 x 4 band around a structure at the top of the wall to which the lookouts are attached

   J. Overhang--Projection of the roof of a structure beyond the wall

   K. Plancier--Underside of the cornice; sometimes called a soffit

2. Styles of cornice (Transparency)

   A. Horizontal box cornice

   B. Sloping box cornice

   C. Open cornice

3. Parts of a cornice (Transparency)
   - A. Fascia
   - B. Lookout
   - C. Lookout ledger
   - D. Soffit mold or frieze
   - E. Plancier or soffit
   - F. Rafter
   - G. Blocking
4. Types of cornice molding (Transparency)
   - A. Crown
   - B. Cover
   - C. Bed
5. Types of exterior wall coverings
   - A. Horizontal siding
     1. Wood
     2. Composition board
     3. Aluminum
   - B. Shingles
     1. Asbestos
     2. Wood
     3. Insulated
   - C. Verticle grooved panels
     1. Plywood
     2. Composition board
   - D. Boards and battens

5. Types of exterior wall coverings (Continued)

   E. Masonry

      1. Brick veneer

      2. Rock veneer

      3. Stucco

6. Styles of siding (Transparencies)

   A. Bevel siding (lap siding)

   B. Plywood siding

   C. Drop siding (shiplapped)

   D. Drop siding (tongue-and-grooved)

7. Material estimating

   A. Cornice

      1. Gable roof

         a. Determine the type of wall covering to be used from the specifications

         b. Determine the style of cornice to be used from the specifications

         c. Determine the running feet of fascia needed for the eave and for the barge

            (NOTE: The fascia must be wide enough to project at least one-half inch below the plancier.)

         d. Determine the running feet of one by four lumber needed for the lookout ledger

            (NOTE: The lookout ledger must extend to the outside of the barge rafter at both ends of the building for attachment of the end lookouts.)

         e. Determine the length and number of lookouts needed for two-foot centers

            (NOTE: Lookouts need to extend from barge to barge on both sides of the building.)

7. Material estimating (Continued)

f. Determine the number of sheets of plywood needed for the plancier

(NOTE: The area in square feet under the eave and rake divided by thirty-two equals the number of sheets.)

g. Determine the lineal feet of frieze needed

(NOTE: Cover all areas where the plancier meets the vertical wall covering of the building.)

2. Hip roof

a. Determine the type of wall covering to be used from the specifications

b. Determine the style of cornice to be used from the specifications

c. Determine the running feet of fascia needed around the perimeter of the roof

(NOTE: The fascia must be wide enough to cover the false fascia and project at least one-half inch below the plancier.)

d. Determine the running feet of one by four lumber needed for the lookout ledger

e. Determine the length and number of lookouts needed for two-foot centers

f. Determine the number of sheets of plywood needed for the plancier

(NOTE: The area in square feet under the eave divided by thirty-two equals the number of sheets.)

B. Siding

1. Determine the type of siding to be used from the specifications

2. Determine the wall area to be covered

(NOTE: Disregard door and window openings. Siding is generally purchased by the square foot.)

7. Material estimating (Continued)

3. From the table below add the necessary percentages for overlap and waste

Allowances for Overlap and Waste on Siding		
Siding	Nominal Width, In.	Percentage Added to Wall Area
Bevel	6	40
	8	25
	10	20
	12	15
Tongued and Grooved	6	20
	8	15
	10	10

C. Nails required for exterior wall coverings and trim

Amount of Nails Required	
Cornice Work Siding	1 lb per 100 lin ft of Cornice Material
6d	6 lb per 1,000 sq ft
7d	6 1/2 lb per 1,000 sq ft
8d	9 lb per 1,000 sq ft
10d	11 lb per 1,000 sq ft

9.0 Plumbing

UNIT GOALS

After completion of the unit, the student will be able to locate information on working drawings to determine type and placement of various plumbing fixtures and installations in a partially framed house. The student will also gain helpful information on plumbing as a career. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms associated with plumbing to the correct definition.
2. Discuss trends and working conditions for plumbers.
3. Properly join ABS and copper pipe.
4. Locate plumbing information on blueprints

9.0 Plumbing

1. Terms and definitions

   A. Branch--Any part of a piping system other than a main

   B. Building drain--Part of the lowest section of a building drainage system that receives the discharge from all the drainage pipes inside the building and carries it outside to the building sewer.

   C. Building main--Water supply pipe in the building including fittings from the street main to the first branch of the water distributing system.

   D. Building sewer--That part of the building drainage system that extends from the building drain to the street sewer or other place of disposal.

   E. Burr--Rough edge on metal left by cutting tool

   F. Compression coupling--Fitting used to join two sections of pipe without threading

   G. Cutting--Sectioning material into predetermined lengths

   H. Diameter (plumbing)--Nominal commercial measurement as used for piping

   I. Die--Tool used in cutting threads on pipe

   J. Drain--Any pipe that carries used water or water born wastes in a building drainage system

   K. Fixture--Any receptacle which receives and discharges water, liquid or water born wastes into a drainage system

   L. Grade--Slope of pipe usually expressed as the fall in inches per foot in length of pipe

   M. Main--Principal pipe of a water supply or sewer system

   N. Offset--Combination of elbows or bends which brings a section of pipe out of direct line

   O. Pipe cutter--Tool used to cut pipe to length

   P. Plumbing--All the pipes, fixtures and other apparatus that bring in the water supply and remove liquid and water born wastes

1. Terms and definitions (Continued)

   Q. Reaming--Process of cleaning inside lip of pipe after cutting

   R. Riser--Water supply pipe that extends vertically one full story or more

   S. Siphonage--A flow of water due to difference in air pressure on the inlet and outlet sides as in a trap

   T. Stack--Vertical main of any system of piping

   U. Threading--Process of cutting thread on pipe end with die and ratchet

   V. Trap--Fitting that allows free passage of wastes but provides a seal of liquid to prevent the return passage of air and gases through it

   W. Union--Coupling joint used in repairs to provide intermediate access to line without complete disassembly from beginning of line

   X. Vent--Pipe installed to provide air within a drainage system to protect trap seals from siphonage and back pressure

2. Employment information trends

   A. Employment opportunities for plumbers and pipefitters will grow through the 1980s.

   B. Plumbing growth relies on construction activity

   C. Air conditioning, solar heating and new kitchen appliances will create new plumbing challenges

   D. Fuel and power-plants will expand and create plumbing and pipefitting jobs

3. Working conditions

   A. Pipefitters' and plumbers' work is strenuous

      1. Working in awkward positions or standing for long periods

   B. Injury rate for contracted employees is higher than for manufacturing firms

3. Working conditions (Continued)

(NOTE: Special learning activity:

Jobsite Visitation, Invite Job Specialist)

4. Places of Employment

A. Plumbers or pipefitters work for contractors or are self-employed

1. There were 428,000 workers in 1978

5. Hiring Practices

A. Plumbers and pipefitters learn their trade in two ways

1. Helpers to journeymen for several years

2. Enter an apprenticeship program (sponsored through union-management agreements)

B. Apprentice helpers spend four years in on-the-job training

C. Classroom training is for 216 hours a year

D. Applicants must be eighteen years old

1. A high school diploma is desirable with chemistry, math, mechanical drawing, physics and shop courses

2. Some communities require a trade license

a. Trade license determines knowledge of trade and local plumbing codes

6. Wage Scale

A. In 1978 plumbers averaged over $10 per hour

B. Apprentices receive 40% to 50% of rate paid journeyman workers

1. Increases are paid every six months

7. Common Worker Benefits

A. Unemployment Insurance

1. Purpose

7. Common Worker Benefits (Continued)

a. Transition from job to job

b. Ease strain of layoffs

2. Source of benefits

a. Payroll tax on wages

3. Eligibility

a. Depends on base year earnings

b. Depends on reasons for leaving work

4. Level of benefits

a. Level of base year earnings

5. Claims process

a. report to Employment Division office

b. Provide required information

1) Employer's name and address

2) Your social security number

(NOTE: Suggested learning activity:

ILS Common Worker Benefits

Invite Field Rep

Workmen's Compensation Board

BOL Wage and Hour

Employment Division

10.0 Electrical

UNIT GOAL

After completion of this unit, the student will be able to locate information on working drawings to determine type, and placement of electrical fixtures. The student will also gain helpful career information about electrican, and electrical trades. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms associated with electrical work to correct definition.
2. Discuss trends and working conditions for electrician.
3. Locate electrical information on blueprints.
4. Demonstrate the ability to:
   - A. Pull wire
   - B. Nail electrical outlet boxes
   - C. Make electrical connections

10.0 Electrical

1. Terms and definitions

   A. Ampere (amp)--Unit of electric current

   B. Cable--Stranded insulated conductor

   C. Circuit--Wire pathway for electrical current

   D. Circuit breaker--Device designed to interrupt electrical current flow if shorts occur and to turn off current for repair to wiring

   E. Conduit--Metal tubing used to enclose electrical wiring

   F. Continuity tester--Device used to determine if electrical circuits are complete and properly functioning

   G. Current--Transmission of electricity through a conductor

   H. Fuse--Protective device used in electrical circuits. Available in wide range of amperage loads. If circuit overloads fuse will break circuit and interrupt flow of electricity

   I. Gauge--System of classifying wire by measuring thickness

   J. Ground--Conducting line between electrical equipment and the ground to protect against shocks

   K. Insulation--Material used to bar the passage of electricity

   L. Ohm--Unit measure of resistance

   M. Outlet/receptacle--Electrical fixture placed in circuits for plug in appliances

   N. Short (circuit)--Passage of electrical current by a shorter route than designed for it

   O. Switch--Device to start and stop flow of current in an electrical circuit

   P. Tubing/conduit bender--Tool used to form conduit to shape for installation

   Q. Twist nuts--Screw cap device used to secure and protect joints/splices in wire

1. Terms and definitions (Continued)

   R. Volt--Practical unit of electromotive force which causes current of one amp to blow through the resistance of one ohm

   S. Watt--Unit of power represented by current of one ampere produced by the electromotive force of one volt

   T. Wire--Metal drawn into form of a thread or cord used as a conductor of electricity

   U. Wire cutter/stripper--Tool used to cut wire to length and remove insulation for connections

   V. Tubing cutter--Tool used to cut conduit to desired length

2. Employment information and trends

   A. Job increase for electricians in 1980s will parallel most other occupations

   B. Construction activity will influence demand for electricians

3. Working conditions

   A. Electrical work requires less strength and much endurance

   B. Most work is indoors

   C. Injury rate has lowered due to safety practices

   D. In 1978, about 270,000 construction electricians worked for electrical contractors

      1. Some were also self-employed

   (NOTE: Suggested learning activity:

   Jobsite Visitation
   Invite Job Specialist

4. Hiring Practices

   A. Applicants requirements include people who are 18 years of age or over

      1. Must have high school diploma, one year of algebra

      2. Need to be healthy, not color blind, dexterous and agile

4. Hiring Practices (Continued)

   B. Some cities require a license to practice as an electrician

   C. More electricians than other construction workers learn their trade through apprenticeship

   D. The 4-year apprenticeship program also require 144 classroom hours annually

   E. Helpers (who are not apprentices) can learn on the job by picking up practical knowledge as they work

5. Wage scale

   A. Electricians on the average earned $11 an hour in 1978

   B. Seasonal changes do not noticeably affect a worker's earnings

   C. Apprentices earn 50% of journeyman level

   D. Most workers are members of International Brotherhood of Electrical Workers

6. Common worker benefits

   A. Unemployment Insurance

      1. Purpose

         a. transition from job to job

         b. ease strain of layoffs

      2. Source of benefits

         a. Payroll tax on wages

      3. Eligibility

         a. Depends on base year earnings

         b. Depends on reasons for leaving work

      (NOTE: Suggested learning activity:

      Explain and discuss, ILS Common Worker Benefits
      Invite Field Rep
      Workmen's Compensation Board
      BOL Wage and Hour
      Employment Division

11.0 Insulation

UNIT GOALS

After completion of this unit, the student should be able to identify the major types of insulation, indicating advantages for each. The student will be able to estimate the amount of material needed, and be able to properly install it to industry standards. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit the student should be able to:

1. Match terms associated with insulation to correct definition.
2. List standard sizes of insulating products.
3. State advantage of using certain types of insulation products.
4. Estimate amount of material for a house.
5. Demonstrate the ability to:
   A. Install batt and loose fill insulation.

11.0 Insulation

1. Terms and definitions
   - A. Heat transfer
   - B. Radiation
   - C. Radiant heat
   - D. Conduction
   - E. Convection
   - F. Condensation
   - G. R factor
   - H. U factor
   - I. Loose fill
   - J. Flexible
     1. Batt
     2. Blanket
   - K. Rigid
     1. Foam
2. Installation procedure--Batt
   - A. Measure required length and mark length on floor
   - B. Unroll blanket and align with marks on floor
   - C. Allow an extra 2 or 3" and cut insulation with a fine-toothed cross-cut hand saw, shears or large knife
   - D. Remove strip of insulation from each end to provide space for stapling at top and bottom
   - E. Emphasize that appropriate protective clothing should be worn at all times, regardless of ambient temperature. Fibres are quite irritating to the skin
3. Stapling
   - A. Begin at ceiling and staple top end to plate

3. Stapling (Continued)

   B. Place remaining portion of batt securely in place and staple flanges to studs on each side

   C. Staple flanges to studs 12" o.c., maximum

   D. Butt second batt securely against first and staple along flanges with a staple gun

   E. Continue process until reaching bottom. At bottom, staple last batt securely against adjoining batt and along flanges and against sole plate

   F. Thread insulation around drain pipes

   G. Do not cover electrical boxes. Push as much insulation as possible around and behind them

4. Loose fill

   A. Install vapor barrier on underside of joists prior to application of ceiling finish materials if possible. If not, drape polyethylene films from joist to joist, loosely enough to allow material to "hug" joists when fill is applied

   B. Emphasize safety precautions to be observed when blowing or pouring fill-type insulation; i.e., use of protective eye and breathing apparatus, gloves, etc.

   C. Pour or blow material into spaces between joists. Do not compress or vibrate to settle

   D. Screed material with a long straightedge, bringing to level of top of joists. If an excess has been applied, it is better to push excess into corners and along perimeter of outside walls

12.0 Dry wall

UNIT GOALS

After completion of this unit, the student should be able to list the standard sizes and shapes of gypsum wallboard. The student should be able to state the advantages of using gypsum wallboard, estimate the amount of material needed, install gypsum wallboard, and apply laminated gypsum wallboard. This knowledge will be evidenced by completing the assignment sheet, job sheets, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with dry wall application to the correct definitions.
2. List the standard sizes of gypsum wallboard.
3. List the standard shapes of gypsum wallboard.
4. State advantages of using gypsum wallboard.
5. Estimate the amount of material needed to finish the interior walls and ceilings of a room with gypsum wallboard.
6. Demonstrate the ability to:
   A. Install gypsum wallboard

12.0 Dry wall

1. Terms and definitions

   A. Backing--Strips of wood nailed at the inside angles of walls and partitions to provide solid corners for nailing the wallboard

   B. Dimple--Impression formed in the surface of gypsum wallboard when the nail is driven to the proper depth

   C. Dry wall--Type of construction where the interior finish material used is something other than plaster, such as gypsum wallboard

   D. Featheredge--Anything which tapers off to a thin feather-like edge

   E. Gypsum board--Modular panels from one-fourth to five-eights inch thick, four feet wide, and six to sixteen feet in length composed of a core of gypsum sandwiched between two layers of paper

   F. Joint--Place where two pieces of wallboard meet

   G. Joint cement--Specially prepared cement used to bond the perfatape to the gypsum wallboard at the joints

   H. Perfatape--Perforated paper joint tape approximately two inches wide and in 60-, 250-, and 500-foot rolls

   I. Topping--Specially prepared substance in heavy paste form used to cover the perfatape and fill in the joint

2. Standard sizes of gypsum wallboard

   A. Thickness

      1. 1/4 inch

      2. 3/8 inch

      3. 1/2 inch

      4. 5/8 inch

   B. Width--4 feet

2. Standard sizes of gypsum wallboard (Continued)

   C. Length

      1. 6 feet

      2. 8 feet

      3. 10 feet

      4. 12 feet

      5. 14 feet

      6. 16 feet

      (NOTE: 1/2" x 4' x 8' is the most common size of gypsum wallboard.)

3. Standard edge shapes of gypsum wallboard (Transparency)

   A. Tapered edge

   B. Square edge

4. Advantages of using gypsum wallboard

   A. Easy to apply

   B. Low cost

   C. Easy to maintain

   D. Saves time

   E. Noncombustible

   F. Provides a good base for applying other finish materials, such as paneling, ceramic tile, accoustical tile, or wallpaper

5. Estimating the amount of material needed to finish the interior walls and ceiling of a room with gypsum wallboard

   (NOTE: The unit of measurement for gypsum wallboard is square foot.)

   A. Determine the total ceiling and wall area to be covered

      (NOTE: No allowance is made for window and door openings unless the opening is exceptionally large.)

5. Estimating the amount of material needed to finish the interior walls and ceiling of a room with gypsum wallboard (Continued)

   1. Compute the area for each room separately

      (NOTE: This is done to cut down on the number of joints by ordering wallboard of a size or combination of sizes to more nearly fit the room.)

   2. Combine the various sizes of wallboard into groups to facilitate ordering (Transparency)

      Examples: 50 pieces 1/2" x 4' x 12' tapered

      120 pieces 1/2" x 4' x 8' tapered

      20 pieces 1/2" x 4' x 10' tapered

      (NOTE: Ceiling wallboard should run at right angles to the joist and horizontally on the walls whenever possible.)

   B. Determine the fastening and finishing materials required using the table below (Transparency)

Fastening and Finishing Materials Required for 1,000 Square Feet Gypsum Drywall

Material	Amount
1 1/4" annular ring nail	6 1/4 lb
1 3/8" annular ring nail	6 3/4 lb
1" drywall screw	3 lb
1 1/4" drywall screw	4 1/4 lb
1 5/8" drywall screw	5 1/2 lb
Joint compound	50 lb (25-lb bags)
Perforated tape	360 to 400 ft (50-foot rolls)
Texture paint	10 to 50 lb (25-lb bags)

(NOTE: Different drywall adhesives have different coverage capabilities. It is, therefore, recommended that the estimator check the coverage for the type of material to be used.)

   C. Determine the number of outside metal corners needed

      (NOTE: Any outside corner that will not receive casing or any other treatment should be protected with a metal corner.)

13.1 Stair construction

UNIT GOALS

After completion of this unit, the student should be able to identify the parts of a staircase, state the rule of thumb for unit rise and unit run, calculate the number of risers and treads, and list the items to consider in building a staircase. The student should also be able to lay out, cut, and assemble a housed stair. This knowledge will be evidenced by completion of the assignment sheet, job sheet, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with stair construction to the correct definitions.
2. Identify the parts of a staircase.
3. Identify the basic types of stairs.
4. Identify the ways stairs are fitted into the building.
5. State the rule of thumb for unit rise and unit run.
6. Calculate the number of risers and treads for a stair of given dimensions.
7. List factors that must be considered in building a staircase.
8. Estimate the materials for a housed stair.
9. Identify methods of securing stringers.
10. Demonstrate the ability to lay out, cut, and assemble a housed stair.

13.1 Stair construction

1. Terms and definitions

   A. Baluster--Upright support of the handrail for a stair

   B. Head room--Clear space between the tread of a stair and the ceiling above

   C. Handrail--Rail on a stair used for support; sometimes called a baluster rail

   D. Housed stair--Staircase in which the stringers are housed between two walls

   E. Landing--Platform introduced at some point to change the direction of the stairway or to break the run

   F. Line of flight--Angle of ascent of a stair

   G. Newel post--Upper or lower post which supports the handrail of a stair

   H. Nosing--Rounded edge of a stair tread that projects over the riser

   I. Open stair--Stair which has both sides open to a room or hall

   J. Rise--Distance between two landings

   K. Riser--Vertical distance under the edge of a stair tread which may be open or closed

   L. Run--Horizontal distance from a point at the head of a stair to the outside end of the last riser

   M. Semihoused stair--Staircase which has one side open to a room or hall

   N. Staircase--Complete flight of steps leading from one floor or story to another above

   O. Stairwell--Compartment extending vertically through a building in which stairs are placed

   P. Stringer--Inclined supports of a flight of stairs

   Q. Tread--That portion of a step on which the foot is placed when mounting the stairs

13.1 Stair construction

2. Parts of a staircase (Transparency)

   A. Headroom

   B. Landing

   C. Rise

   D. Run

   E. Tread

   F. Riser

   G. Stringer

   H. Unit rise

   I. Unit run

   J. Nosing

   K. Baluster

   L. Newel post

   M. Handrail or baluster rail

   N. Stairwell

   O. Clearance

   P. Nosing piece

3. Types of stairs (Transparency)

   (NOTE: Stairs are classified by shape and by the way they are fitted into the building.)

   A. Straight flight

   B. Straight flight with landing

   C. L-shaped

   D. Winder

   E. Circular

4. Ways stairs are fitted into a building (Transparency)

   A. Housed

   B. Semihoused

   C. Open

5. Rule of thumb for unit rise and unit run--Total of one riser and one tread should not be less than sixteen or more than eighteen inches (Transparency)

   A. Unit rise should be 7" - 8"

   B. Unit run should be 9" - 11"

   (NOTE: As the rise increases, the run must decrease proportionally.)

   (CAUTION: All treads and all risers for a stair must be of the same size.)

6. Calculating the number of risers and treads for a stair (Transparencies)

   (NOTE: A stair chart may also be used. See chart on next page.)

   A. Risers

      1. Determine the total rise of the stair in inches

         (NOTE: The total rise of a stair is from the finished floor of the lower level to the top of the finished floor of the upper level.)

      2. Divide the total rise of the stair by seven to get the number of risers needed

         (NOTE: The number seven is the minimum height of a riser.)

      3. Round back to the nearest whole number

      4. Divide by number of risers to get unit rise

6. Calculating the number of risers and treads for a stair (Continued)

   B. Treads

      1. Determine the total run of the stair in inches

         (NOTE: The total run of the stair is the horizontal distance from a point at the head of a stair to the outside edge of the last riser.)

      2. Divide the total run of the stair by nine to get the number of treads needed

         (NOTE: Nine inches is the minimum width of a tread.)

      3. Round back to the nearest whole number

      4. Divide by a number of treads to get unit run

7. Factors to be considered in building a staircase

   (NOTE: Refer to building code.)

   A. Width

      (NOTE: The minimum width is three feet and preferably four feet.)

   B. Headroom

      (NOTE: The minimum allowable headroom is 6'-8" for a main stair and 6'-4" for a basement or service stair.)

   C. Line of flight

      (NOTE: The preferred angle for a stair is from 30 to 35 degrees.)

   D. Unit rise

      (NOTE: The unit rise should be from seven to eight inches to be comfortable, but all risers for a stair must be of uniform height.)

7. Factors to be considered in building a staircase (Continued)

   E. Unit run

      (NOTE: The unit run should be from nine to eleven inches to be comfortable, but all treads for a stair must be of uniform width.)

   F. Baluster rail height

      (NOTE: The distance from the top of the baluster rail to the top of a tread, at the middle, should be no less than thirty-two inches and no greater than thirty-six inches.)

8. Material estimating for a housed stair

   (NOTE: See building specifications for kinds and dimensions of material.)

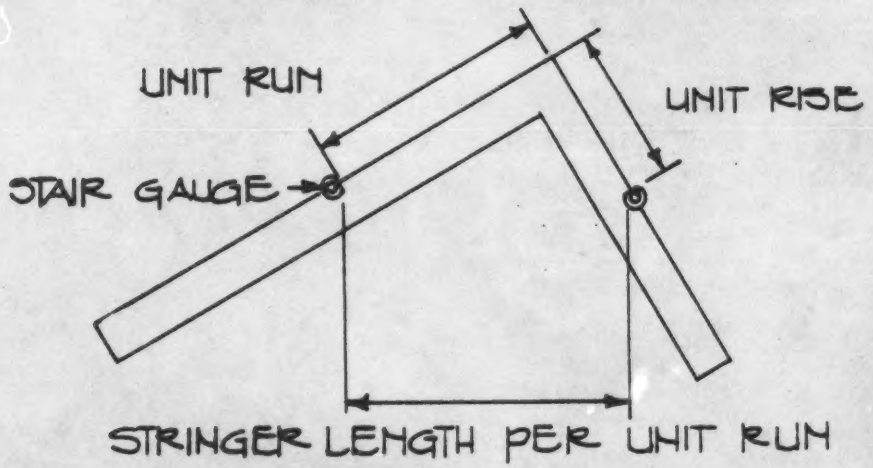
   A. Stringers

      1. Determine the length needed

         a. Determine the number of risers and the number of treads

         b. Determine the unit rise and unit run

         c. Locate the unit rise and the tongue of a framing square and the unit run on the blade



(NOTE: The diagonal measurement from the unit run to the unit rise on the square illustrated above equals the stringer length per unit run.)

8. Material estimating for a housed stair (Continued)

d. Multiply the stringer length per unit run, in inches, by the number of treads to get the length of the stringer in inches

e. Divide by twelve to get the length of the stringer in feet

f. Add two feet for waste at each end

2. Determine the number of stringers needed from the specifications

(NOTE: A minimum of two are needed for a stair thirty-six inches wide.)

B. Treads

1. Determine the width of a tread

(NOTE: The width of a tread is the unit run plus the amount of nosing desired.)

2. Determine the thickness of a tread

(NOTE: For a basement stair, the treads are usually made from two-inch material.)

3. Determine the length of a tread

(NOTE: For a housed stair, the length of a tread will be the distance between the two walls that house the stair.)

4. Multiply length of a tread by the number of treads to equal the running feet of material needed

C. Risers

1. Determine the height of a riser

(NOTE: The unit rise will be the height of the riser.)

8. Material estimating for a housed stair (Continued)

2. Determine the thickness of the riser

(NOTE: Risers are usually cut from one-inch material.)

3. Determine the length of the risers

(NOTE: For a housed stair, the length of a riser will be the distance between the two walls that house the stair.)

4. Multiply length of a riser by the number of risers to equal the running feet of material needed

D. Nails

1. 16d casing (for treads)

(NOTE: It takes approximately three pounds of 16d casing nails for a basement stair.)

2. 16d box (for stringers)

(NOTE: It takes approximately two pounds of 16d box nails for a basement stair.)

3. 8d box (for risers)

(NOTE: It takes approximately two pounds of 8d box nails for a basement stair.)

E. Baluster rail

(NOTE: The rail should be the same length as the stringers and one for each side.)

9. Methods of securing stringers (Transparency)

A. Ledger strip

B. Hangers

C. Nailed from rear

13.2 Door hanging and trim

1. Terms and definitions

A. Apron--Piece of trim placed horizontally under the stool

B. Baseboard--Finishing board covering the edge of the wallboard where the wall and floor meet

C. Base shoe--Small narrow molding used around a room at the base of the baseboard

D. Butt--Type of door hinge where one leaf is mortised into the edge of the door and the other leaf is mortised into the side jamb

E. Casing--Framework of trim around a window or door

F. Clearance--Spacing between the edge of a door and the jamb

G. Cope--To cut or shape the end of a piece of molding so it will cover and fit the contour of an adjoining piece of molding

H. Cove molding--Molding with a concave profile used primarily for trim where the wall meets the ceiling

I. Door frame--Assembly of wood parts that form an enclosure and support for a door

J. Gain--Notch or mortise cut to receive a hinge or other hardware

K. Head jamb--Top member of a door frame

L. Jig--Contrivance used for guiding tools while work is being done

M. Miter joint--Ends of any two pieces of board of corresponding shape cut off at an angle and fitted together in an angular shape

N. Quarter round--Type of molding which presents a profile of a quarter of a circle

O. Side jamb--Vertical side posts of a door frame

P. Stool--Base or support at the bottom of a window that extends into the room

Q Template--Gauge which is used as a guide for forming or shaping

1. Terms and definitions (Continued)

   R. Threshold--Wood or metal member used to close the space at the bottom of a door at the sill

   S. Trim--Visible finishing work in a building

   T. Reveal--That part of a jamb between edge of jamb and trim; usually 3/8"

2. Parts of an interior door unit (Transparencies)

   A. Side jambs

   B. Head jamb

   C. Blocking

   D. Door

   E. Casing

   F. Door stop

   G. Rough header

   H. Trimmer stud

   I. Butts

   J. Lockset

   K. 45^{o} miter joint

3. General types of interior door construction (Transparency)

   A. Solid core

   B. Hollow core

4. Hand of a door (Transparency)

   (NOTE: When installing locks, the hand of a door is determined by facing the door from the outside of the building for exterior doors and from the security side for interior doors.)

   A. Right hand (RH)

      (NOTE: The butts are to your right and the door swings away from you.)

4. Hand of a door (Continued)

   B. Left hand (LH)

      (NOTE: The butts are to your left and the door swings away from you.)

   C. Right hand reverse (RHR)

      (NOTE: The butts are to your right and the door swings toward you.)

   D. Left hand reverse (LHR)

      (NOTE: The butts are to your left and the door swings toward you.)

5. Dimensions of interior doors and frames

   A. Standard interior door sizes

      (NOTE: Door sizes are always given in this order: thickness, width, and height, such as 1 3/8" x 2'-8" x 6'-8")

      1. Thickness--1 3/8"

         (NOTE: This is standard unless otherwise specified.)

      2. Width

         a. 2'-0"

         b. 2'-4"

         c. 2'-6"

         d. 2'-8"

         e. 3'-0"

      3. Height--6'-8"

         (NOTE: This is standard unless otherwise specified.)

   B. Standard interior jamb sizes

      (NOTE: Interior jambs are specified by the door width, length, and the thickness of the finished wall, as 2'-8" x 6'-8" x 4 1/2" interior jamb.)

5. Dimensions of interior doors and frames (Continued)

1. Width

(NOTE: If the opening is greater than 2'-8", an extra side jamb may be cut to the correct length and used as a head jamb.)

a. 2'-0"

b. 2'-4"

c. 2'-6"

d. 2'-8"

e. 3'-0"

2. Length--6'-8"

(NOTE: This length is standard unless otherwise specified.)

3. Thickness--4 1/2"

(NOTE: This thickness is standard for a 2 x 4 stud wall with 1/2" gypsum wallboard on both sides. If paneling is used over the wallboard, the jambs will need to be specially ordered or made on the job.)

C. Casing--May be purchased precut to the jamb size or in random lengths of odd and even feet to be cut on the job

D. Door stop--May be purchased precut to the jamb size or in random lengths of odd and even feet to be cut on the job

6. Parts of a window installation (Transparency)

A. Window unit

B. Head jamb

C. Side jamb

D. Stool

E. Casing

F. Apron

7. Types of joints commonly used to install casing and trim (Tranparency)

   A. Miter

      (NOTE: A miter joint is used on outside corners and is usually forty-five degrees but may be greater or less depending on the corner.)

   B. Coped

      (NOTE: A coped joint is used on inside corners and may be cut to fit almost any inside angle.)

8. Types of molding (Transparency)

   A. Casing

   B. Baseboard

   C. Door and window stops

   D. Quarter round

   E. Base shoe

   F. Cove

   G. Bed

   H. Corner

9. Types of doors according to installation (Transparencies)

   A. Swinging

   B. Bypass

   C. Bifold

   D. Pocket

   E. Multifold

10. Material estimating

   A. Doors

      1. Type

      2. Size

10. Material estimating (Continued)

3. Number of each

B. Jamb sets

1. Size

2. Number of sets of each size

C. Casing--Sets or lineal feet

1. Sets for specific door sizes

2. Lineal feet for windows, odd size openings, and aprons

D. Butts-Pairs

1. Size

2. Number of pairs

E. Baseboard--Lineal feet

(NOTE: Order enough to go around the perimeter of the room and inside closets.)

F. Door stop--Sets

1. Sizes

2. Number of sets for each size

G. Base shoe--Lineal feet

(NOTE: Order the same amount of base shoe as baseboard.)

H. Window jamb and sills

(NOTE: Order one board foot of the type of lumber specified for each foot or part of a foot of area around an window.)

I. Locksets

1. Type

a. Passageway (bedrooms)

b. Privacy (bathrooms)

c. Keyed (entrance)

10. Material estimating (Continued)

2. Style

3. Brand

4. Number of each

J. Other trim--Lineal feet as needed

1. Outside corners

2. Cove molding

3. Bed molding

4. Quarter round

K. Nails

1. Door frames, 8d casing, 1/5 lb per frame

2. Door trim, 6d finish, 1/2 lb per opening

3. Window trim, 6d finish, 1/4 lb per side

4. Baseboard, 6d finish, 1 lb per 100 lin ft

5. Base shoe, 2 lb per 1,000 lin ft

13.3 Cabinet and Shelf Installation

UNIT GOALS

After completion of this unit, the student should be able to identify the parts of a cabinet, the types of cabinet door installation, items of cabinet hardware, and joints used in cabinet construction. The student should be able to install a custom-built cabinet and install shelves in a closet. This knowledge will be evidenced by completion of the job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with cabinet and shelf installation to the correct definitions.
2. Identify the parts of a cabinet.
3. Identify types of cabinet door installation.
4. Identify items of cabinet hardware.
5. Identify joints used in cabinet construction.
6. Name types of cabinets.
7. Demonstrate the ability to:
   - A. Install a custom-built cabinet.
   - B. Install shelves in a closet.

13.3 Cabinet and shelf installation

1. Terms and definitions

   A. Fixtures--Display and storage units

   B. Counter unit--Base unit of a cabinet having a working surface

   C. Hardware--Those items in building construction that permit movement, are decorative, or are both; includes hinges, catches, pulls, and knobs

   D. Knob--Projection, usually round, for opening doors and draws

   E. Plastic laminate--Hard, laminated plastic material used as a covering for counter tops

   F. Pull-Projecting device in the form of a handle for opening doors and drawers

   G. Rail--Horizontal bar of wood used to separate drawers and doors on the face of a cabinet

   H. Stile--One of the vertical members used to separate doors and drawers on the face of a cabinet and to support the top

   I. Toe space--Recessed space at the floor line of a base cabinet or other built-in that permits one to stand close without striking the vertical surface with toes

   J. Wall cabinet--Upper portion of a cabinet that is wall hung above the base cabinet

   K. Soffit--Underside of any subordinate member of a structure, such as the undersurface of an arch, cornice, or stairway

   L. Back splash--Vertical continuation of a counter top at the back and ends

   M. Shelves--Pieces of wood or other material fastened horizontally to a wall to hold objects

   N. Scriber--Tool with a sharp point and a pencil point used to make marks

13.3 Cabinet and shelf installation (Continued)

2. Parts of a cabinet (Transparency)

   A. Toe space

   B. Soffit

   C. End panel

   D. Rail

   E. Stile

   F. Shelf support

   G. Shelf

   H. Drawer guide

   I. Drawer

   J. Door

   K. Hinge

   L. Pull

   M. Knob

   N. Counter top

   O. Back splash

3. Types of cabinet door installation (Transparency)

   A. Lipped

   B. Surface

   C. Flush

4. Cabinet hardware (Transparency)

   A. Knob

   B. Pull

   C. Friction catch

   D. Magnetic catch

   E. Semi-concealed hinge for 3/8" lipped doors

13.3 Cabinet and shelf installation (Continued)

F. Semi-concealed hinge for flush doors

G. Concealed hinge for flush doors

H. Monorail drawer guide

5. Joints used in cabinet construction (Transparency)

A. Butt joint

B. Dado joint

C. Rabbet joint

D. Miter joint

E. Coped joint

6. Types of cabinets

A. Custom-built or mill-built

B. Modular or stock units

14.0 Trowel trades

UNIT GOALS

After completion of this unit, the student will be able to explain about current trends and working conditions for the trowel trades. Also the student should have a good idea of what is involved in the trowel trades as far as skills and physical requirements. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of the unit, the student will be able to:

1. List facts concerning trends and working conditions.
2. Name employment opportunities.
3. List major skills for each of the trades, plaster, brick, cement, and tile.
4. Match terms associated with trowel trades.
5. List major skills for:
   - A. Plaster
   - B. Brick
   - C. Cement
   - D. Tile
   - E. Dry wall

14.0 Trowel trades

1. Terms and definitions

   A. Admixtures--Compounds added to basic compound to change its characteristics/properties

   B. Aggregate--Inert particles, usually sand and gravel used in making concrete and mortar

   C. Grout--Plaster like compound used to fill joints in tile setting

   D. Hydration--Chemical reaction that happens when cement paste hardens, bonding aggregate together in a solid mass

   E. Grade--Elevation or height to which you are working

   F. Concrete--Mixture of aggregate, portland cement and water which hardens into rock-like mass.

   G. Cement--Finely ground powder made by burning and grinding limestone and clay. Ingredient used as hardening, bonding agent in concrete

   H. Mortar--Plastic mix of cementatious material, fine aggregate and water

   I. Keenes cement--High strength white gypsum gauging plaster

   J. Dry pack--Leveling base material used in the setting

   K. Lath--Base material for plaster, gypsum board, metal and wood are common materials for lath. Used to provide bonding strength.

   L. Gypsum--Processed gypsum rock. Generally fine white powder form

   M. Rodding/striking off/screeding--Straight edge pulled across material to provide even, level surface

   N. Plasticity--Ability to be spread, moved about

   O. Air entertainment--Capturing microscopic air bubbles in the concrete through additions of special chemical agents

   P. Buttering--Placing mortar on masonry unit with a trowel

   Q. Bed joint--Horizontal layer of mortar on which masonry unit is laid

14.0 Trowel trades

R. Head joint--Vertical mortar joint between ends of masonry units

S. Jointing--Process of tooling or facing the mortar joints

T. Bond--Patterns formed by exposed faces of masonry units

U. Nominal dimension--Dimension equal to the actual masonry dimension plus thickness of one mortar joint

V. Double up--When plaster is applied first in a thin coat then immediately a second coat is put over it

W. Trowel--Hand-held tool with metal blade of varying size and shape used to apply material to surfaces or prepare surface finish

X. Hawk--Platform tool used to hold and carry the various mortars

Y. Darby--Flat surfaced tool with handle used to float surfaces

Z. Kumalong--Long handled tool used to spread and distribute concrete

AA. Serrated trowel--Trowel with serrated edge used to spread mastic/adhesives

BB. Screeds--Wood lattic device used as thickness guide for applying materials to surfaces

2. Trends

A. Employment for trowel trades workers is expected to increase rapidly during the 1980s.

B. As population and economy grow, masons will be needed to build apartments, offices, highways and other structures

1. A greater use of concrete as a building material

C. New products such as epoxy and latex flooring systems stimulate the demand for cement workers

D. Employment of cement masons is not expected to rise as rapidly as the use of concrete products

14.0 Trowel trades

1. Many concrete products are pre-cast and do not require finishing

E. Construction methods and materials have improved worker efficiency and reduced the need for as many skilled employees

3. Working conditions

A. Masonry work is active and strenuous

1. Most cement finishing is done at ground level, while other trades may work on scaffolding stories high

2. Workers must often stoop, bend and kneel

B. Most jobs are outside and work halts during rainy or freezing weather

NOTE: Suggested learning activity:

Jobsite Visitation
Invite Job Specialist

4. Places of employment

A. The majority of trowel trades workers in 1978 worked for general contractors who construct entire project

B. Also work for contractors who do only masonry work

C. Some cement masons work for specialty floor contractors

D. Trades workers are also employed by public agencies and manufacturing firms who do their own construction work

E. One out of eight cement masons is self-employed specializing in small jobs; a norm that holds true for most of the trowel trades

5. Hiring practices

A. Workers learn their job on construction sites and assisting cement masons

B. Workers also learn the trade in two or three year apprenticeship programs

14.0 Trowel trades

C. Apprentices receive on-the-job training in addition to a minimum of 144 hours of classroom training each year

D. Employers prefer to hire high school graduates who are 18 years old and licensed to drive

1. Consider the ability to work as a team member and to direct others as important assets

E. Other helpful assets are high school courses in shop, mathematics, blueprint reading and mechanical drawing

6. Wage scale

A. Current wage scales average about $10 per hour

B. Apprentices begin at 50% to 60% of the rate journeymen receive

C. Annual earnings may not be as high as hourly rates indicate

1. Poor weather and fluctuating construction conditions lead to unstable employment

15.1 Painting

UNIT GOALS

After completion of this unit, the student will be introduced to the areas of painting common to both exterior and interior finishing. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms associated with painting.
2. Identify by type and characteristics, the basic paints. (oil, latex, enamel)
3. Demonstrate ability to:
   - A. Prepare surfaces for painting
   - B. Paint a room using brush and roller
   - C. Adjust, operate, and clean spray equipment
   - D. Prepare surfaces for and paper a room
4. Accurately estimate materials for papering and painting of a house.

15.1 Painting

1. Types of paint

   A. Latex paints are based on three types of emulsions. They are polyvinyl acetate, polyacrylic and polystyrene butadiene. In these paints, pigments are suspended in the non-water portion of a colloidal suspension. When the water is evaporated, a tight soluble film is formed. They have little odor, are easy to apply and dry rapidly. Interior latex paints are generally used as either primers or finish coats on interior walls and ceilings that are made of plaster or wallboard. Exterior latex paints are used directly on exteriors such as masonry or on primed wood. They are non-flammable, economical and have excellent color and color retention. Latex paint films are somewhat porous so that blistering due to moisture or evaporation is less of a problem than with solvent-thinned paints. They do not, however, adhere readily to chalk or dirty surfaces.

   B. Oil paints are the oldest type of coatings in use and have longest history of performance. They are used primarily on exterior woods and metals since they dry too slowly for interior use. Linseed oil is the major binder in oil house paints. Oil paints come in a solid pigment as well as oil stains. Oil stains are based on a drying oil such as linseed oil in which color pigments are dispersed to a low density. In this way, maximum penetration is obtained when applied to wood. Interior stains are applied generously to sanded, dust free surfaces and allowed to dry for a short period of time. The excess is then wiped off; that portion of the stain which has penetrated the wood remains.

   C. Enamels are relatively fast drying and smooth out to a hard finish. Enamels are used on woodwork due to their washability. Instructor should point out that enamels come in water-base, as well as oil-base paints.

2. Spray equipment

   A. In a conventional sprayer the paint is placed in a closed container called a pot. The introduction of air pressure from a compressor forces the material through the hose to the spray gun. The gun is connected to a separate hose. At the gun the material is atomized by air supplied through the central opening of the air cap. This has been for years the most common spray technique, but it tends to create excessive overspray because of the high ratio of air to paint used. Small jobs are sprayed with guns which can be attached to quart jars of paint from which paint is fed to the gun either by pressure or by vacuum.

15.1 Painting

B. The airless spray uses hydraulic pressure. Equipment is similar to conventional spray equipment, except that pressures are much higher. Atomizing is accomplished by forcing the material through a special shaped diaphragm at pressure between 1500 and 3000 pounds per square inch. These pressures produce a high speed stream of paint at the orifice. When the paint leaves the orifice, the release of the pressure causes the paint to atomize. There is no air turbulence to direct the paint in this system and rebound is greatly reduced--thus a more uniform coverage is possible with this type of system.

C. Viscosity of the paint: It must be low enough to permit proper atomization but high enough to apply without running or sagging. Generally, a trial and error approach is required.

D. Pot pressures: This determines the amount of material forced through the nozzle. Pot pressures are controlled at the air regulator gun.

E. Atomizing process: This is the air pressure supplied to the gun to atomize the material and produce a uniform wet film. Too much pressure here will cause excessive overspray or dry spray. Too little pressure produces a speckled or dimpled effect.

F. Air cap on spray gun: This controls the amount and distribution of air mixed with the coating at the gun. The amount of air and air pressure controls atomization while the distribution of the air determines the shape of the spray pattern.

G. Material orifice (nozzle): The size of this opening controls the amount of material that can be passed through the gun.

H. Air and material controls on gun: These are for rough adjustment of amount delivered.

(NOTE: Adjust paint viscosity only when necessary and then according to manufacturer's instructions. Excessive thinning results in needless overspray, excessive runs and sags, poor hiding and inferior surface protection. During application, use the lowest material and air pressures that result in quality finish with good flow out.

Material pressure is best adjusted starting at the point where a solid stream of paint will flow out about 24" from the gun with the atomization air turned off. When the material is heavy and viscous, when the fluid hose is extra long, or when a more rapid rate of application is required, it will be

15.1 Painting

necessary to also increase the air pressure since it is important to maintain a proper ratio of material-pressure-to-atomizing-air-pressure. There is no set rule for spray gun pressures because they will vary with the nozzle used, the paint used and surface to be coated. To reduce over-spray, use the minimum pressure necessary.)

3. Using spray equipment

A. Adjust the spray pattern. Spray width adjustment screw is turned clockwise for a round pattern and counter-clockwise for a fan pattern. Turn the material control screw clockwise to increase the flow. As the width of the pattern is increased, increase the flow of paint to maintain the same coverage over a wider area.

B. Keep the spray gun 6" to 10" from the surface to be coated. Holding the gun too far away causes "dusting" in which the paint solvent evaporates in midair and the coating hits the surface in a nearly dry state.

C. Keep gun perpendicular to surface. Tilting the gun causes the paint to be more heavily applied on one area of the spray pattern than another. Use a free-arm motion moving parallel to surface at all times and feather out at the end of the stroke by pulling the gun trigger after beginning the stroke and releasing it before the stroke is completed. When spraying corners, stop 1" to 2" short of the corner. Then hold the gun so as to sweep up and down along the edge of the corner and hit both sides at the same time.

4. Cleaning spray equipment

A. Emphasize that it is absolutely essential that all tools and equipment be cleaned thoroughly, immediately after use and before paint materials have a chance to get hard. Remove as much paint as possible, then clean thoroughly with a compatible solvent. Clean two or three times in fresh solvent until no paint is noticeable. Wipe clean and dry. With good care, all tools and equipment will last much longer and will always be in prime condition for use.

15.2 Papering

1. Preparing wall for papering

A. Demonstrate using a steamer to remove excess paper when old paper is not firm

15.2 Papering (Continued)

B. Emphasize that when papering over old paper, seams must be sanded smooth

C. Demonstrate removing old paper by soaking with warm water and scraping off with a broadknife

D. Remove all dirt or grease from wallboard or plaster surfaces, note that in drywall construction, excessively wetting paper should be avoided

E. Clean painted surfaces and sand all enamel, semi-gloss or glossy surfaces

2. Papering the wall

A. Remove wall plates from electrical fixtures. Stress safety considerations. Ensure that power is switched OFF at the box, and that the switch box is appropriately labeled

B. Ensure that all wall surfaces are prepared

C. Strike a plumb line to ensure that paper will run along straight, vertical lines. Start at a prominent part of the room such as near a door or window.

D. Measure distance from ceiling to baseboard (or floor as necessary).

E. Cut as many full length strips as necessary to complete a run. Cut, allowing enough material to overlay ceiling and floor edges and following manufacturer's recommendations for matching patterns.

F. Place paper, face down, on paste table and apply a thin coat of paste to the back of the sheet. Apply using either roller or brush, but ensure that coating is uniform and runs smoothly out to the edge.

G. Fold (but do not crease) sheet to bring pasted surfaces together. If necessary, sheet may be doubled over again. This is done to facilitate carrying and working with the paper.

H. Working from top down, start hanging first strip. Ensure that strip's edge is aligned with plumb guide line.

I. Brush upper portion of strip into place and continue unfolding bottom half of paper. Brush out all bubbles. This is the most important part of the job, so time spent in extra careful alignment and installation is needed.

15.2 Papering (Continued)

J. Position next sheet, matching patterns at top. Install as before.

K. After joining strips, remove any excess paste from paper and joints. Use a clean sponge.

L. Remove excess paper from bottom of sheet using a straight-edge and a razor blade or cutting wheel.

16.1 Floor coverings

UNIT GOALS

After completion of this unit the student should have a thorough understanding of floor covering materials and installation methods. This knowledge will be evidenced by completing jobs, assignments, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match list of terms applicable with flooring covering.
2. Discuss trends, working conditions, and hiring practices for floor coverings.
3. Estimate floor covering materials.
4. Demonstrate ability to:
   - A. Install pad and carpet
   - B. Install sheet vinyl
   - C. Install floor tile
   - D. Prepare underlayments for various floor coverings

16.1 Floor coverings

1. Terms and definitions

A. Carpet--Fiber floor covering designed to spread from wall to wall

B. Rugs--Carpeting cut to fit areas less than wall to wall

C. Rebond--Shredded foam bonded together to form padding material

D. Tile--Floor covering material made of vinyl or vinyl asbestos mixture, comes in pre-cut squares

E. Underlayment--Base material, often partical board, over which floor covering is laid

F. Tack strip--Pre-nailed strips used to fasten carpeting securely against edge of room, two types designed for wood and concrete applications

G. Mastics/adhesives--Materials used to attach tiles and vinyl securely to subflooring

H. Vinyl--Man made plastic compound used to formulate sheet floor covering

I. Seam--Joint where two pieces of flooring are joined, may be stitched, taped or fused

J. Grade--Term used to denote quality of flooring

K. Pile--Length of fiber extending from carpet backing

L. Lofting--Fiber treatment to add bulk but not weight

M. Gauge--Number of ends of surface yarn per inch across carpet

N. Pattern repeat--Measurement denoting distance before pattern starts over again, used for matching purposes

O. Layout--Marking centerlines for starting tile using a tape and chalk line

P. Roller--Weighted cylindrical tool used to press floor coverings into mastics or adhesives

Q. Utility knife--Hand-held knife with replaceable straight edged blade, used to cut floor covering material

16.1 Floor coverings

R. Linoleum knife--Hand-held knife with hooked nose blade used to cut linoleum and other sheet coverings

S. Chalk line--Chalk covered string used to mark layout on floors for tile

T. Trowel--Hand-held tool with serrated edged metal blade used to apply mastic and adhesives

U. Stair tool--Chisel shaped tool with broad, dull head used to secure carpet to tack strip

V. Knee kicker--Spring loaded device with adjustable resistance and teeth used to stretch carpeting

2. Trends

A. Approximately 88,000 floor covering installers were employed in 1978

1. Almost 4/5 of those installers worked with carpets, the rest worked with resilient flooring

B. Most installers work for flooring contractors, retailers of floor covering or repair contractors

C. About one out of three workers in the trade are self-employed, a higher percentage than most of the building trades

3. Working conditions

A. Installers work under favorable conditions compared to other construction trade workers

NOTE: Suggested learning activity:

Jobsite Visitation
Invite Job Specialist

B. Work areas are often safe and comfortable because floor coverings are almost exclusively designed for interior use and display

C. Physical demands may include kneeling, reaching, stooping, stretching and lifting heavy rolls of carpet

1. Even with continual movement and use of some hand and power tools, fewer injuries occur than among other construction workers

16.1 Floor coverings

4. Hiring practices

A. Most floor covering installers learn the trade by working as helpers for experienced installers for 1½ years, or through formal apprenticeship programs

B. Employers want applicants who are at least mechanically inclined, licensed to drive, and have a high school education

5. Employment Opportunities

A. Employment for floor covering installers is expected to increase faster than the average for all occupations through the 1980s

1. Due to expansion in construction and more widespread use of resilient floor coverings and carpeting

B. More job opportunities will be available for installers who can do both carpet and resilient flooring

6. Wage scale

A. Floor coverers earned between $7 and $9 per hour in 1978

1. Apprentices and trainees earned approximately half the experienced workers wage

B. Installers are paid by the hour, receive a monthly salary, or are paid according to the amount of work they finish

C. Installers generally work regular schedules, unless circumstances require working evenings or weekends

16.2 Estimating tile

A. Demonstrate use of tile estimation tables

B. Demonstrate determining tile requirements by hand. Start by determining the square footage of the area

C. Multiply area (in square feet) by 1.7778. This will give the number of tile required, if tile is standard 9 x 9 tile. For 9 x 18, 1/2 as many will be needed as

16.2 Estimating tile

for 9 x 9 tile; alternately, multiply area (in square feet) by .889.

D. For 12 x 12" tile, the number of tile required equals the number of square feet; for 6 x 6 file, the number required is four times that for 12 x 12 tile

E. Allow for waste. Standard waste figures are as follows:

0 to 50 square feet, allow 14 percent for waste
50 to 100 square feet, allow 10 percent for waste
100 to 200 square feet, allow 8 percent for waste
200 to 300 square feet, allow 7 percent for waste
300 to 1000 square feet, allow 5 percent for waste
Over 1000 square feet, allow 3 percent for waste

16.3 Estimating carpet requirements

A. Point out difference between real and theoretical yardage requirements

B. Discuss determining theoretical yardage requirements. Demonstrate dividing room into their component rectangles, triangles and circles. Give appropriate formulae for determining areas of each of these components; i.e.,

area of a rectangle	=	length x height
area of triangle	=	1/2 x base x height
area of circle	=	πr^2, where $\pi = 3.1416$ and r^2 = radius of circle (multiplied by itself)
one square yard	=	9 square feet

C. Discuss determining actual yardage requirements. Emphasize that in final layout, patterns must match, all carpet must lay in same direction and offset seams in high traffic areas (preferably all seams in high traffic areas) must be avoided.

D. Have students experiment, on paper, with carpet installations of varying types. They should calculate waste for carpet installed with seams running one direction, and with seams running the opposite direction. In addition, they must determine advantageous starting points to obtain balanced and optimum matching of patterns consistent with low waste. Once layout has been determined, actual waste may be calculated.

16A Installation

1. Laying out and installing padding

   A. Measure room and plan layout. Do not allow seams in padding to match seams in carpet. Otherwise, no special considerations are necessary.

   B. Roll out padding in a large, flat area if possible. (Often, the largest room is used for layout, and installed last.)

   C. Measure laid-out padding carefully using a steel tape measure.

   D. Make 1/2" cuts in edges of padding with shears wherever cuts are required.

   E. Snap chalk lines between cuts to determine line of cut. Do not trust cutting along pattern lines, etc., as they may be deceptive.

   F. Cut padding along chalklines using heavy carpet shears.

   G. Lay out padding in room for installation. Abutt pieces against one another.

   H. Tack or staple abutting ends in place, or on concrete fasten to floor with a recommended adhesive. Ends may also be sewn or taped.

   I. Tack outside edges, spacing tacks closely (usually 6" apart) or staple.

   J. Trim outside edges to allow for installation of tackless stripping, as necessary.

2. Installing carpet

   A. Prepare floor and install tackless strips if this has not been done. Cut carpet to size and sew or glue strips together. Roll up and move into work area.

   B. Unroll carpet and position in room. Lap edge up wall by about 3/8" using a small awl.

   C. Press carpet flush with wall using fingers. Repeat ironing carpet to wall with carpet hammer. Ensure that carpet is hooked for about a foot along each wall at the starting corner.

1C A Installation

D. Using the knee kicker, alternately stretch and hook carpet to strip all along first wall (usually the long one). Or, use power stretcher with extensions as necessary and stretch carpet and hook to opposite corner on same wall. Iron against strip and wall.

E. Starting again at starting corner, iron carpet against short wall. Stretch as before and hook all along tackless strip. Iron carpet along strip and against wall.

F. Using power stretcher, stretch and hook carpet along length of room opposite first applied wall. Stretch will also have to be applied toward final corner. Carpet may be alternately stretched and hooked in both directions until it lays flat.

G. When hooking is complete, iron into position.

H. Force carpet into gully between tackless strip and wall using a small awl, putty knife, etc.

3. Running vinyl and fitting it to endwalls.

A. Measure room from end to end in the direction desired to lay floor. (Seams should be minimized.)

B. Roll out first strip of vinyl, face inward to uncurl material

C. Measure vinyl, adding about 3" to total length and cut.

D. Position vinyl and butt against endwall. Set a pair of scribers (or dividers) to maximum distance between wall and vinyl, and scribe off this distance on material. Cut along scribed line.

E. Spread adhesive and butt material against endwall. Leave a space about 3' wide at opposite end of room free of adhesive.

F. Position vinyl and press into place. Lap free end up against remaining endwall.

G. Set dividers or scribers to a wide space (9 to 12" or so). Mark this distance on floor adjacent to selvage edge of vinyl material.

H. Also mark this distance on selvage edge of material itself. Mark need not cover entire width of material; in fact, a thick mark will do.

I. Pull flooring back and buckle so that end may be abutted to endwall.

J. Measure distance between mark on selvage edge of vinyl. Set dividers or scriber to this distance.

K. Trace this distance along end of material by running scriber parallel to endwall. This is the cut line.

L. Cut material and check fit. Spread adhesive and glue into position.

4. Laying out and setting tiles to a diagonal

A. Square room and snap chalklines as for standard installation.

B. From center point O, take any convenient radius and snap points W, X, Y and Z on center lines.

C. Strike diagonals at a 45° angle to center lines. To do this, take any radius greater than OX or OY and make intersecting arcs at point A. Using the same radius and points YZ, ZW and WX, strike points D, B and C as before. Strike diagonal chalklines AB and CD.

D. Using lines AB and CD as center lines for room, lay out tile, adjust center point, and install tile as in any regular installation.

5. Laying out tile

A. Measure perimeter of floor surface with tape measure

B. Square-off room

C. Snap chalklines around squared-off area

D. Measure off half length and width of squared-off area

E. Snap chalklines from half points of one width to half points of other width. Repeat for half points of room length.

5. Laying out tile (continued)

   F. Beginning at center, lay out rows of tile along center lines, moving in each direction.

   G. If less than one full tile is required to complete rows in either direction, adjust centers so that end pieces of equal width may be laid.

   H. Mark new room "center" if changed.

6. Installing plywood underlayment materials

   A. Mention that plywood underlayments are applied to wood double floors with top layers of 3" tongue-and-groove boards and single wood floors with 3" or less tongue-and-groove boards.

   B. Mention that material should be 1/4", solid-core interior plywood, A.P.A. underlayment grade.

   C. Cover subfloor with roofing felt. This ensures a quiet finish floor.

   D. Measure, cut and lay out sheets in ashlar style, long side parallel to sidewalls and subflooring.

   E. Position sheets 1/64" apart. This space is conveniently measured by wedging a paper matchbook cover between sheets.

   F. As units are spaced, fasten to subfloor with 3d ring-grooved or cement-coated nails. Nails should be closely spaced (usually 4" o.c.)

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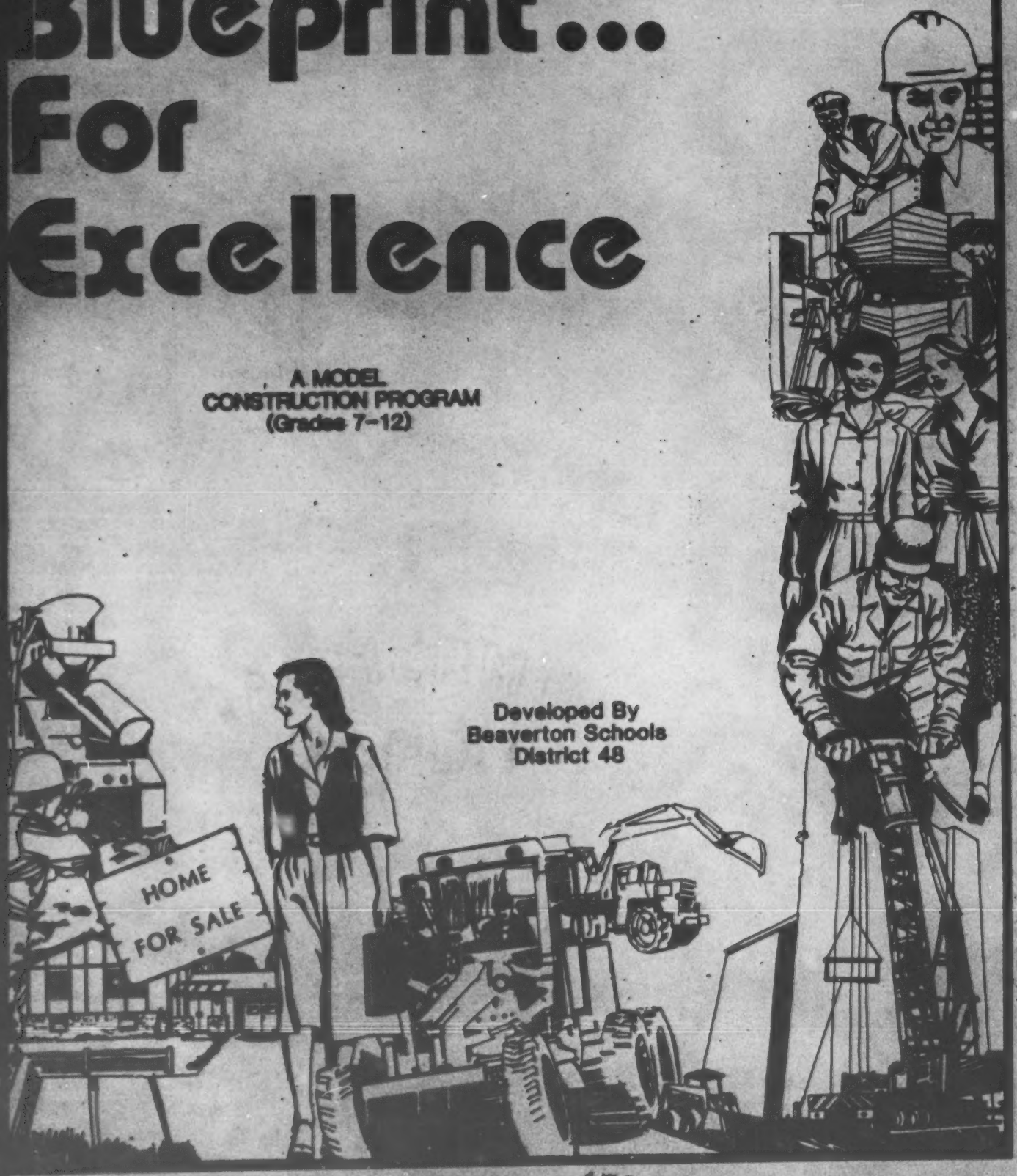
APPENDICES

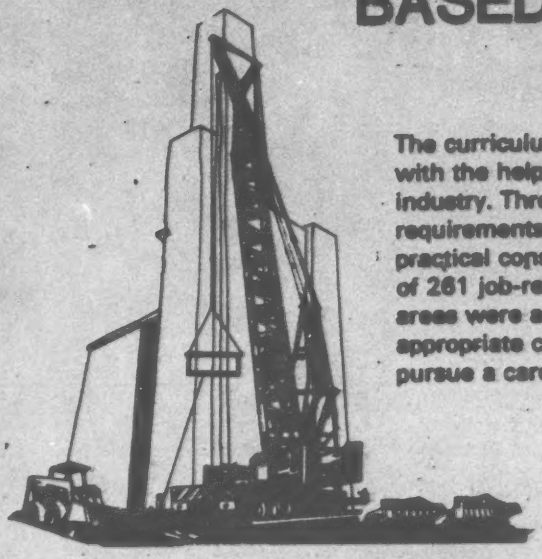
Blueprint... For Excellence

A MODEL
CONSTRUCTION PROGRAM
(Grades 7-12)



Developed By
Beaverton Schools
District 48

GOAL I DEVELOP AN INDUSTRY BASED CURRICULUM



The curriculum of the construction program was developed with the help of representatives from the construction industry. Through interviews, identification of on-the-job requirements and careful evaluation, a realistic and practical construction curriculum was written and a total of 261 job-related sub-tasks across seven general task areas were analyzed as the basis for development of an appropriate course of study for students who wish to pursue a career in the construction field.

GO

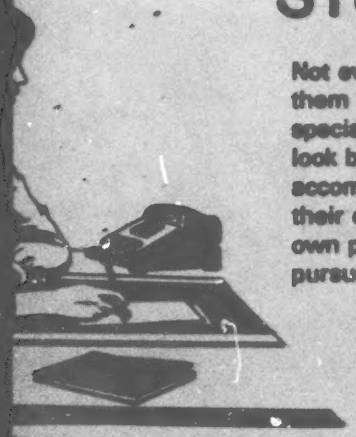
GOAL II INCREASE STUDENT SUPPORT SERVICES

Student support services play an important role in the success of the program. Guidance and counseling services help students explore their interests and abilities. Career centers, set up in each school, provide career information and offer students a wide choice of careers to explore. Both the counseling services and the career centers assist students in planning and preparing for a career in the construction industry.

In-class activities also assist students in their choices. Industry representatives speak to classes about various job opportunities and requirements. Class field trips to construction industries also help students explore work roles. These industry-related experiences assist students in making their career decisions.

To understand the impact on our graduates, a follow-up study is planned which will provide information from both students and employers on how well students are prepared to enter their chosen career area. This activity will help establish and maintain a high standard of instruction in the program.

GOAL III INCREASE SERVICES FOR STUDENTS WITH SPECIAL NEEDS



Not every student is motivated by school; others have handicaps which may cause them to think their career options are limited. In the model construction program, special efforts are made to reach these students. Teachers teach all students to look beyond stereotype attitudes which may build barriers to personal accomplishment. Students with special needs are taught how to get involved in their own life decisions, to explore requirements of a career and to examine their own potential. They are also assisted in the development of skills required to pursue the career of their choice.

AL IV INCREASE COMMUNICATION "BRIDGES"

The model construction program promotes communication activities of both school and community to bridge the information and awareness gap which may exist. Counselors and teachers increase their understanding of skill requirements, knowledge of apprenticeship programs and other work opportunities available to students talking with potential employers. Representatives of the construction industry increase their knowledge and understanding of the school's efforts by serving on advisory committees and assessment panels. Through these communication links, the program provides an avenue for continuous dialogue between the program managers and the industrial community.

Activities are also planned with instructors at community colleges and universities to provide construction teachers with information on post high school programs available to students.

GOAL V INCREASE UTILIZATION OF COMMUNITY RESOURCES

Support from local contractors, labor representatives and other members of the community indicates a high degree of interest in the model construction program. Continued utilization of the skills and expertise of these people as well as the close relationship with Portland Community College will help ensure students a quality educational experience. The schools will continue their efforts to recruit industry personnel to assist in assessment and further goal-setting to assure the maintenance of an outstanding program. The District's commitment to working with the community and utilizing a wide range of community resources for the benefit of our young people is the cornerstone of this *"Blueprint for Excellence."*

ABOUT THE PROJECT.....

This project was funded through a grant from the Vocational Education Division of the Oregon Department of Education. The model will serve as a guide for the design, development and implementation of similar construction programs in other school districts throughout the State of Oregon.

A unique aspect of the development of this model was the high degree of participation by members from all facets of the construction industry. Nearly one hundred craftsmen, supervisors, and management personnel were personally interviewed to identify job-related tasks. Support and cooperation came from nearly every trade union within the metropolitan area. The District is grateful for this high level of support and interest during the [illegible] of the pilot project.

Project Participants

District Instructional Staff

Steering Committee

John Corey, Highland Park [illegible] School
Steve Davies, Highland [illegible] School
Susan Eilertsen, Beaverton High School
Gloria Gibbs, Beaverton High School
Ken Kline, Beaverton High School
Bill Lapp, Whitford Intermediate School
Tom Morris, Beaverton High School
Ralph Powell, Beaverton High School
Chuck Steury, Special Education
Don Stevens, Whitford Intermediate School

Industrial Arts Curriculum Committee

Ed Korver, Highland Park [illegible] School
Will Thomas, Cedar [illegible] School
Wayne Estvold, [illegible] High School
Don Lary, Meadow [illegible] School
Wayne Bridges, Five Oaks Intermediate School
Ralph Powell, Beaverton High School
Ken Kline, Beaverton High School

Other Personnel

Citizens Advisory Committee

Dennis Arit, Cabinet maker and general contractor
Randy Cobb, Heating [illegible]
Walt Nilson, Building trades in[illegible]
John Kennedy, Plumbing con[illegible]
Ed Morlan, Bureau of Apprentic[illegible]
Don Plumbo, Former student
Paul Reiter, Electrician
Paul Salmeri, Sheetrock [illegible]
Dave Sanchez, Ov[illegible] contracting business

Oregon Department of Education

Ralph Little, Project Monitor
[illegible] Specialist, Construction
John Pheasant, Specialist, Industrial Arts

Project Consultants

Burt Fancher[illegible] Associates, Albany, Oregon
Larry Kennel[illegible] Evaluator, Oregon State [illegible]
[illegible] Universi[illegible], Oregon
[illegible] Garrett, West Linn, Oregon

District Administration

[illegible] Applegarth, Superintendent
[illegible] Russell, Director of Instruction
Ken Bell, Curriculum Specialist - Project Director

For More Information About This Project
Contact Beaverton School District
P.O. Box 200, Beaverton, OR 97075
503-[illegible]-3000